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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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## The late Mr. William Mayer.

The British foundry industry has suffered a great loss with the passing of Mr. William Mayer, of Dumbarton. This is especially sad as last week saw the culmination of one of his life's works, and we doubt whether he would be cognisant of the fact. We refer to the awarding of the John Surtees medal, in the Newcastle area. Mr. Mayer gave a sum of money to provide medals both in Scotland and Tyneside, primarily to advance the art of moulding, and secondarily to perpetuate the name of John Surtees, who is credited with the introduction and development of dry-sand moulding.

Mr. Mayer was born in the county of Durham in 1852, and in 1898 was appointed manager to Messrs. Hardie & Gordon, Levenbank Foundry, Dumbarton, in which firm he later became a partner. He was one of the first to become a member of the British Foundrymen's Association on its inception in 1904. To the Association he gave his whole energies, and was rewarded in 1915 by his election to the presidential chair, the highest honour attainable by a British foundryman. During his year of office he visited every Branch. It should be remembered that at this period no social functions were possible, and travelling to and from Scotland was unpleasant in the extreme. None but an exceptional enthusiast would have dreamt of such an undertaking. At the end of his year of office he presented the Association with a handsome and costly gold chain, to which later he added a further eight links.

A perusal of Mr. Mayer's presidential address indicates very clearly the interest he took in the history of engineering and foundry work. He visualised more than any other foundryman the importance and influence of foundry work on civilisation. This was in his mind when he said "Malleable iron at that time was both scarce and dear, being £60 per ton, until Henry Cort, the ironmaster of Gosport, with his great foresight and keen discernment (and to whom a statue should have been erected in gold for what he did for the world at large, and Britain especially), saw what it was possible to achieve with iron. He took out patents for the puddling furnace and grooved rolls. By his system the cost of making malleable iron was so largely reduced, and the production so much increased, that railways became possible that previous to that had been impracticable. Cort must therefore rank as one of the railway pioneers." This phrase is typical of Mr. Mayer's speeches, which were quite often designed to teach the world the importance of foundry work, and so raise the status of the foundry. No Britisher has ever done more propaganda work for the founder than Mr. Mayer. To his relatives we offer, both on behalf of the foundry trades of Great Britain and the Institution of British Foundrymen, our deepest sympathy. They can rest assured that his description of himself, that of "the most enthusiastic foundryman of Britain," will ever be honoured by the Association of which he was so proud.

## The French International Foundry Congress.

Mr. Wesley Lambert left London last Monday to confer with the representatives of the Association Technique de Fonderie. He will submit the reports of the Committee on International Relationship and its sub-committee. We are informed that Mme. Ronceray has been appointed chairman of the Ladies' Entertainment Committee, which obviously indicates that ladies are included in the invitation. The sub-committee have suggested that the British and American parties should leave London at 9 p.m. on Tuesday, September 11, the official reception being held in the afternoon of September 12; a session, in the English language, on Thursday morning, and a banquet on Friday evening; the party to leave on Saturday evening, arriving in London at 9 a.m. on Sunday, September 16. This arrangement, if confirmed by the French, will allow every visitor to have a maximum period in Paris, with a minimum leave of absence from work.

The visit as outlined will preclude the necessity of any member staying in London overnight, and the constitution of the journey affords ample facilities for the British and Americans to meet each other. To each Branch-President there has been sent the minutes of the International Relationship Committee, and they will receive the sub-committee's recommendations in the course of a few days. There is thus no reason why every attached member of the I.B.F. should not be *au fait* with the work of the London Committee.

B.

# Arc Welding.

Before a recent meeting of the Staffordshire Iron and Steel Institute, held at Dudley, a Paper on Arc Welding was submitted by Messrs. H. W. Wolton and R. W. Heasman, in the course of which the authors, in describing the different systems of arc welding, remarked that there were two main systems. In the first a carbon rod was used as the electrode. This system, however, was not very largely used as it did not lend itself to general work and was only really useful when it was required to repair heavy steel castings, and where, prior to welding up, a large amount of burning away of bad material had to be carried out. Welding flanges on to pipes and branches was also carried out by this process. The deposited metal was hard and difficult to work, and its quality inferior. The second and almost universally-used method was that employing a coated metal electrode. This electrode formed the positive pole of the circuit when direct current was employed, and the arc was maintained between that and the work to be welded.

### Electrode Compositions.

Continuing, Mr. Wolton, who read the Paper, stated that the coating of the electrode is of varying compositions, each maker having his own special preparation, but its function is to supply a flux consisting of a fusible slag which, melting at a slightly lower temperature than the metal core of the electrode, causes an air-tight coating to be always covering the molten metal during welding, and on cooling it entirely prevents oxidation either during the welding operation or during the earlier stages of the cooling down of the deposited metal. These coated electrodes are supplied to any specification so that, when necessary, repairs can be effected in any class of work, and further, any particular steel alloy can be deposited by means of arc welding.

This question of the coating of electrodes has received such careful attention that cast iron, manganese steel, nickel steel, stainless steel and other alloy steels are successfully arc welded and deposited by the use of the correct electrodes with suitable flux coatings. Bare electrodes are still used—when alternating current is employed they cannot be used at all—and for any work where direct current is employed they should not be used where a strong and ductile weld is required. The coated electrode will always give sounder results; when it is used, not only is oxidation effectually prevented, but sticking of the electrode to the work when welding is avoided.

### A.C. Plant More Popular.

A most important point of consideration to manufacturers is the small capital outlay required for the installation of an arc-welding plant, and further it can be installed and worked with equal success with either direct or alternating current. Many conflicting statements are made with regard to the merits of both alternating and direct current for arc welding, but it is generally conceded to-day, by those who are thoroughly conversant with the practical operation of arc-welding plants, that the work can be satisfactorily effected on either system. There are at the present a larger number of A.C. plants than D.C. in use, perhaps for the reason that an A.C. plant can be installed at half the cost of a D.C. plant and that nowadays A.C. is the more general source of power supply.

The striking of the arc is rather a more difficult matter on an alternating current plant, and also when welding on this system coated metal electrodes are a necessity. With direct current an arc can be maintained with a minimum of 45 volts (open circuit), but 60 volts is much easier to work with and is the usual practical pressure. A high voltage permits excessive arc length which makes for poor welds. The open-circuit voltage of alternating current supply for this work should be from 75 to 90 volts. On direct-current plants a resistance is employed for controlling the amount of current necessary to weld with a given size of electrode; while with alternating current a reactance coil is employed.

The plant required for a direct-current arc-welding equipment has to consist of:—A motor-generator, the motor to be at the available supply voltage and the generator to give 60 volts, and a current of up to 200 amps. for a single-arc outfit. A starting switch for the motor and suitable regulating resistance on the welding circuit for controlling the current supply to each arc-welding operator. The latest D.C. welding plant for one operator is of special construction which considerably reduces the size of plant, and gives the same amperage. The voltage of this plant is only 25-30 volts, and no regulating resistance is necessary. Only the amount of current is generated as required by the welder, and no energy is wasted through a resistance. A pressure of 60 volts is always necessary for a plant requiring more than one welder.

For alternating current a single-phase transformer is required, to give 75-90 volts and up to 200 amperes on the secondary side, the primary being wound to suit the supply mains; also a suitable reactance coil for controlling the current necessary for any given size of electrode. Either plant will also require an electrode holder, gauntlets and face shield for protecting the operator's face, eyes and hands from the rays emitted by the arc.

### Importance of Current Density.

The current density at which it is best to work the electrodes is an important point for the operator to study. The use of too much or too little current will produce bad welds. The exact amount of current to use for a given gauge of electrode cannot be stated. It is always better to adjust the amount of current to be passed by the regulators. To weld on a thick plate will take slightly more current than welding on a thin one with the same size electrode. When steel plates are welded together with a butt joint it is necessary to V the sides forming a total V of about 70 deg. For plates up to ¼-in. thick, the sides are not shaped in that way, but the edges of the plates left open. The V is first welded with a small electrode and the welding continues layer upon layer, each with a larger electrode. For coated electrodes No. 14 gauge wire would require a welding current of about 40 amperes, while for No. 4 gauge it would be 180-200 amperes.

With reference to arc-welding repairs, the authors mention that in rolling mills much useful work can be accomplished with an arc welder. Steel and iron roll-wobbler ends can be built up to the correct size and shape. Broken teeth may be welded or built up on large pinions and cast-iron spur wheels. Coupling boxes also can be reinforced and brought up to correct dimensions. When welding is carried out on cast-iron wobbler ends, it is advisable to stud the surface before proceeding with the welding. This prevents the deposit contracting or cooling down and pulling away from the cast iron. In steel works large ingot moulds with scabs on the sides, sometimes 1½ in. deep, making it impossible to extract the ingot, can be made good by welding, and the mould put back into service.

### Speed of Working.

Regarding the speed of welding, the authors state that arc-welding being very local, the work can be proceeded with at far greater speed than with oxy-acetylene methods, and it is therefore found that very little distortion takes place.

Steel plate ¼-in. thick can be welded with a butt joint at 15 ft. per hour and costs about 6d. per ft. including time, electrodes and electricity.

Plate ⅜-in. thick may be welded at about 8 ft. per hour when making the joint in two runs, the first with a No. 8 gauge electrode at the bottom and the top layer with a No. 6 gauge. Steel plates 1 in. thick, welded together at right-angles to form a corner, can be joined at the rate of 20 min. per ft. run, when using electrodes of $\frac{5}{32}$-in. dia. The average current consumption of metallic arc-welding is from 5 to 10 units per hour, according to the class of plant.

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C. A. Parsons & Company, Limited, electrical engineers, Newcastle-on-Tyne, have secured the contract for the steam turbines and three-phase alternators to be erected at the new Barking Power Station of the County of London Electric Supply Company, Limited. The total output of the new plants will be between 90,000 and 100,000 kws.

# A Discussion on the Camber of Iron Castings.*

MR. R. MCLAREN, A.M.I.Brit.F., in opening the discussion, said he proposed to outline the methods he had to adopt to overcome the difficulties encountered in the range and stone grate trade. Owing to the light nature of these castings there are more problems in camber than in any section of the ironfounding industry, and anyone wishing to study the question will find the work very interesting and sometimes very difficult. For instance, in tiled registers or parlour grates, as they are commonly called in the Manchester area, the size in general use is 38 in. by 38 in., and they do not seem to be difficult castings to obtain straight and to measure the 38 in. both across the top and bottom. The first trial casting is made off the straight lead pattern. The pattern-maker will then have to put in six or seven cambers, and will also consider how much camber will be required for three casts. A dozen trials may have to be made before a correct master pattern is obtained. When a pattern 40 in. by 38 in. is required, one would naturally think that a 1-in. strip put to each side of the pattern is all that is required, but the pattern-maker will be very fortunate to get a correct iron master-pattern without making an alteration to the camber of the lead pattern. It is worthy of note that the section of the tiled register plays a very important part in the amount of camber required.

### Mantel Register.

A tiled mantel register is a mantel and register combined, and the pattern will require different treatment from that given to a tiled register because of the difference in construction. It does not require the same flow of camber, and usually not as many cambers as the tiled register. A mantelpiece which has an opening 37 in. by 37 in. and is usually a strong section, and is used to surround a tiled register or an interior. This pattern may require five or six different cambers. Bedroom mantels are made in a lighter section and are usually made in three sizes, 36 in., 30 in. and 24 in. wide. The first pattern to be made is for the 36 in. size.

When a correct iron master-pattern is made, the lead pattern is then cut down to make the 30-in. mantel. A new plaster may have to be made for the 24-in. mantel. These mantels will have five or six cambers, and each mantel different cambers, in some instances it is very difficult to get both legs of an iron mantel master-pattern to have the same camber when cast. For a kitchen mantel which surrounds a kitchen range, there is a right and left hand leg, a linten and shelf. These are all separate castings. It is necessary that the legs should be straight where they fit against the range. The speaker instanced a case where $\frac{5}{8}$-in. camber has been put in a leg lead-pattern and which was insufficient. The pattern-maker has to be very careful in such cases because if too much camber is put in the lead pattern the iron pattern may retain it all or go the reverse sense. This phenomenon is termed "breaking the back of the camber." It has been said that it is not in the nature of cast iron to take three cambers, and where three cambers are required other methods have to be resorted to. To overcome this difficulty the speaker had to cut the flange of the pattern with a saw in several places so that there should be an even flow of camber. The leg patterns are about 5 ft. 6 in. long by 8 in. wide. The pattern was placed on two trestles face-side down, so that it rested on each end. Weights were then put on to the pattern to give the required camber. A 4-ft. length of $\frac{3}{4}$ in. by $\frac{1}{4}$ in. half-round wrought-iron with a $\frac{1}{4}$-in. hole drilled at each end, was put on to the pattern and marked through the holes. The weights were removed, and $\frac{1}{4}$-in. tapping holes were drilled in the pattern. After tapping out the holes, the pattern and weights were returned to the trestles and then the wrought-iron strap was fixed on to the pattern, sufficient packing being placed through the strap and pattern to hold the camber after the weights had been removed. The space was filled with plaster of Paris, the pattern-moulder having to fill the space in the mould made by the strap. It is advisable to make a trial casting from a pattern that has been treated in this way.

It might be said that instead of so much trouble it would be preferable to heat the pattern and bend it. Having tried both methods with these patterns, the speaker affirmed that he had had better results from the way described.

### Lintel Castings.

The lintel is at all times a very difficult casting to obtain straight, and it has been found necessary to treat them in the same way as the legs. The shelf is also a difficult casting to get straight, as there is invariably something happening to this shelf and to all other mantelshelves that is difficult of understanding, for no matter how even the flow of camber on the lead-pattern, when the iron pattern is made there is a break in the camber about 9 in. from each end. The strapping process had to be resorted to, to get satisfactory results.

### Winding Frame Spindle Plates.

Similar experience was obtained with Rabouth winding-frame spindle-plates. These patterns are 6 ft. 8 in. long by $6\frac{1}{4}$ in. wide. They have a channel section. In this case, a wood master-pattern was used. The camber was all that could be desired to obtain good iron patterns. When the iron patterns were examined it was found that about 12 in. from each end, the flow of camber was broken in the same way as the mantelshelves These plates being of a heavier section they were taken to the smithy fire and heated to a bright red, and bent them till the flow of camber was regular, and the result was good, straight castings.

It is often assumed that there is no fixed law for the camber of castings, but the speaker understands that half-round cast-iron gutters have a fixed camber. The iron working-patterns in many instances are made direct from a plaster pattern with the correct camber. The section of these patterns is 1-10th of an inch thick, the pattern-maker making patterns as long as the plaster holds together. Steel patterns for these gutters are now made in dies, the correct camber being put in at the same time.

## DISCUSSION.

The CHAIRMAN asked what Mr. McLaren would do when the camber in the plate altered after it had been in use.

### Plate Rack Camber Troubles.

MR. MCLAREN said his experience varied. There was one case of a plate-rack in a Yorkshire kitchen range, the plate that was over the fire and the boiler, coming from the top of the oven. When the patterns were sent out, they were quite straight, but after they had been in use for a time, through the rapping, they lifted a bit. To remedy that, they had fire-bricks set out with the camber of the master-pattern. When the plate was hot, it was put on those bricks, and bars of pig-iron were placed on top, weighting it down. It was left till it was cold enough to handle. He had had good results from that.

A MEMBER: Was the exact camber or more given?

MR. MCLAREN replied that they had to find out by experience. If it was not sufficiently hot, it would not "come back"; there was a tendency to lift the whole thing. On one occasion, when 20 ft. of rack had been treated in that way, he found the following morning, when the bars were lifted, that it had "come back" almost to what it was previously. They reheated it, making it hotter. Usually they reached bright red, but on this occasion a higher temperature was reached.

MR. PELL suggested that it was heated until the pattern was, in a sense, "flowing," as used with reference to wrought iron.

MR. MCLAREN replied that such a temperature was not used, as it would certainly break cast iron.

MR. BARNES asked whether the pattern was as strong after treatment as before.

* A discussion before the Burnley Section of the Lancashire Branch of the Institution of British Foundrymen. Mr. J. Hogg in the Chair.

MR. MCLAREN replied that after the pattern had been treated in that way, the operation had to be repeated from time to time. There was always a tendency to rise, and it rose quicker than the first time. It was not quite as strong as before it was heated.

**Cambered Boxes.**

MR. BARNES: Do you make a pattern plate off that?

MR. MCLAREN: Yes.

MR. BARNES: Do you put the camber in the pattern plate?

MR. MCLAREN: Yes.

MR. BARNES: Then you have to make your boxes the same shape as the camber.

MR. MCLAREN said the boxes were not made the same shape as the camber. The camber was put in the frame, and there was sufficient camber in the frame that it would come straight, or nearly so.

MR. BARNES suggested the camber was put in from the pattern.

MR. MCLAREN explained that they did not follow the camber in the pattern. They gave the frame so much camber; it might be $\frac{3}{8}$ in. or 5-16 in., depending upon the length.

MR. BARNES: Suppose the pattern plate comes out straight. What is the casting going to be?

MR. MCLAREN said, if the frame of the plate came out straight, if the pattern had only just come the same as the frame had come, whatever camber the frame was set at, they obtained the necessary camber.

MR. BARNES: It has to be cambered to the line on the top. Is it not policy to have the boxes the same shape as the camber, to follow the plate, instead of having two straight edges for the box?

MR. MCLAREN: Suppose the pattern has $\frac{1}{2}$-in. camber. That is in the middle of the box. When making a plate pattern from it, the frame is not set to the same camber as the pattern. It is a rigid frame. Then if that frame is given, say, $\frac{1}{4}$-in. camber in the middle, and it comes straight, the pattern has only "come" $\frac{1}{4}$ in.

MR. BARNES: Is the casting likely to be straight?

MR. MCLAREN: It is necessary to try the plate. If there is the correct camber on the pattern, the casting will be straight; if not, it will be necessary to make another plate and put more camber on the pattern.

MR. BARNES: How is one going to camber a pattern if the castings are crooked?

MR. MCLAREN: It is necessary to restart.

MR. BARNES: If it becomes crooked in a straight-edge box, is one to make the boxes the same shape as the camber?

MR. MCLAREN said he had never seen it done, as straight-edge boxes are invariably used for plates.

**Rail Castings.**

MR. BARNES said he was once told of a case where they were casting rails 12 or 14 ft. long and could not get them straight. He advised them to make the boxes crooked and wedge underneath the plates, to pull it to the box. There was no difficulty then.

MR. PELL said that was not a correct method. If an unskilled man was put on a plate pattern, he must be given a perfect foolproof base; otherwise there would always be trouble. It was not foolproof if it had to be wedged up and pulled out. It was not the work of an unskilled man to bring camber back to a box. It could not be expected from them.

**Fractures from Heating.**

MR. JACKSON asked what percentage of plates was lost, in which the camber had been restored by heat treatment.

MR. MCLAREN: You mean cracking when they were being heated in the fire?

MR. JACKSON said in a plate which had suffered considerably from rapping, the grains were disturbed, and after being heated to bring the camber back, a fracture was sometimes found on cooling. It might be very small.

MR. MCLAREN said he had only lost three or four. In the light castings the frame would be 5-16 in. thick. That was the heaviest they used.

MR. WILSON asked whether, to bring the camber from crooked to say $\frac{3}{8}$ in., one would start with $\frac{3}{8}$ in.

MR. MCLAREN replied that they did not put the whole of the camber on at once; they added more and more by degrees until satisfactory. No one could say how much it would require until it was tried.

MR. JOWETT asked whether Mr. McLaren had any definite views as to the camber for different lengths of castings.

**No Rule Established.**

MR. MCLAREN said, unfortunately, he had never found any definite rule in regard to camber.

MR. WILSON pointed out that the casting they were discussing had a uniform thickness. It would alter the camber if they thickened some parts of it.

MR. MCLAREN said they did not allow for that sort of thing. The section played a very important part. He pointed out how a difference in the section might stiffen the pattern, or, on the other hand, weaken it so that it required more camber.

MR. BARNES suggested that an alteration in the position of the gates might alter the camber. He had known that to happen.

The CHAIRMAN said they would all agree that Mr. McLaren had given a most interesting address and dealt with the subject in a very able way, especially when dealing with the lintel design and the mantel work, of which so much was done in Scotland. In his experience, he had not come across a case where camber had to be put in six or seven times, but he could quite understand that that might be so. He had experience of camber in heavier sections. One was with regard to some plates of varying size, but he took as an example one that was 6 ft. long by 4 ft. 6 in. A $1\frac{1}{4}$-in. flange was run all the way round, and there were bolt holes all round the edge. A good soft metal was used. If the top part of those plates was allowed to go 10 min. or 15 min., the mischief was done; it bent in the middle. The plates did not fracture at all. If they were taken off across from one end to the other immediately they set, they were straight. Did anyone know a method of stopping that trouble without removing the top plate? Some of the plates were about 10 ft. long by about 3 ft. Those did not buckle in the middle. The flanges were of the same section.

**Bars and Wedges Give Varying Results.**

MR. JOWETT said he had had a similar job. They were tank plates for a brewery. They put bars over the middle and put three iron wedges underneath, one at each end and one in the centre.

The CHAIRMAN said they tried that plan. They put bars in the middle and wedged underneath in three places. The plates always cracked.

MR. JOWETT remarked that, in his opinion, camber in different castings offered a wide field for discussion, but this was the only Paper he had seen in the last four or five years which dealt with the subject. He had been very much interested in Mr. McLaren's Paper, and he would have been better satisfied if Mr. McLaren could have told them of experience in machine toolwork, or rails of any description. He meant holding-down rails for large machine tools, with a section of about 4 in. by 6 in., then tapering to 5 in. He had experienced much trouble with the taper of bars.

MR. WILSON said machines, 6 ft. by $3\frac{1}{2}$ in. thick, having a $\frac{1}{2}$-in. flange on the sides, brought in camber at the end. What he was concerned with was whether there was any definite rule with regard to this matter.

A vote of thanks to Mr. McLaren was passed.

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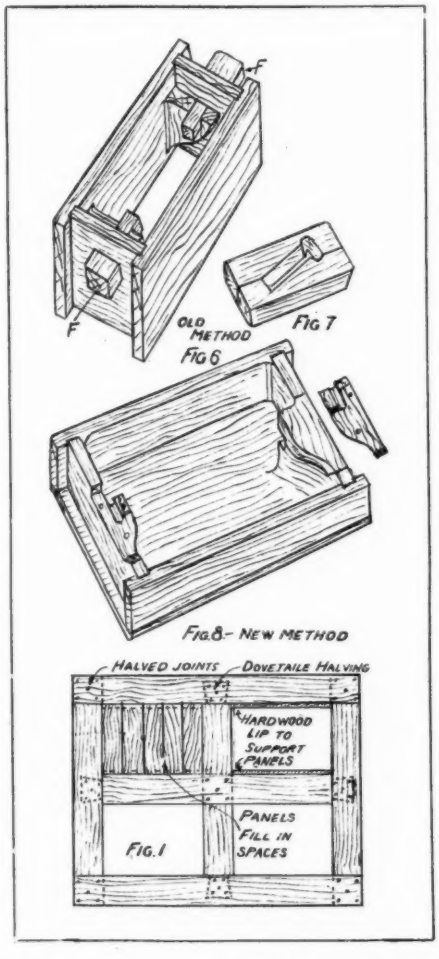
**Societe des Acieries Basset.**—The report of the Tréfileries of Havre, presented at the recent general meeting, states that the Basset concern has during the year continued the experimental work carried on since the formation of that Company. It will be known within the next few months whether the inventor's hopes have been realised in every respect, more especially as regards the costs of production. On the other hand, it is reported that both the Ougrée-Marihaye Company and the Tréfileries concern have withdrawn their representative on the Basset Company's board of directors. Upon inquiry M. Basset asserts against these reports that his Company's works at Dennemont are on the point of producing 1,000 tons of merchant steel per month which it will be possible to sell at 280 fcs. (say, 80s.) per ton.

# A Few Points on Pattern Making.*

By F. C. Edwards, M.Inst.Brit.F.

Patternmaking has really very little in common with either carpentry or cabinet-making. In these trades the work, in practically every case, is an end in itself. Whereas a pattern is a *means* to an end. For instance, in making a door or a chair, the individual requirements of these very useful articles have alone to be considered; their functions are purely intrinsic. If objects of art are ruled out, it may be definitely stated that the sole purpose of a door is to open and shut, and a chair made to sit upon. Similarly, throughout the whole range of joinery and cabinet-making, the articles produced are for direct use; the work is an end in itself.



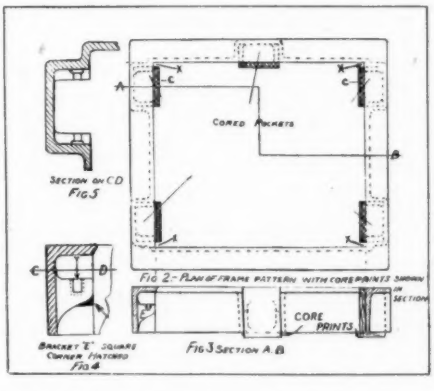

A pattern, however, is made in order to produce a casting, or a number of castings. It is but the *means* of producing the article required. It is the intermediary, and it possesses, as a rule, a very small intrinsic value. Compared with its cost or its value as a means, this intrinsic value is generally infinitesimal. Even if a pattern is almost new and it fails as a means of producing castings, it is, as a rule, comparatively worthless. Perhaps a glaring case of this kind, taken from the writer's personal experience, may be found to contain one or two interesting points.

### How Money can be Wasted in Pattern Making.

Some years ago, upon taking charge of a fairly large pattern shop, the author found in course of construction a plate-pattern, 8 ft. by 9 ft. The panel was $\frac{3}{4}$ in. thick, and it was strengthened by ribs and facings. This panel was made up of two slabs, each $\frac{3}{8}$ in. thick, with the grain crossed at right-angles. It was a mahogany pattern. At the first sight the author expressed doubt as to the serviceability of the job, but as the pattern was nearly finished it was decided to let it go through, just to see actually what would happen. After one or two castings had been made the pattern became quite unmanageable. The moist steaming hot sand in which it was the fate of these plate patterns to be daily buried soon produced the anticipated result. The pattern was made with close-glued joints, all securely screwed together. Imagine the effect, then, of the moisture on each side of this plate. Nine ft. of well-seasoned mahogany, trying to expand under the influence of damp sand, in one direction on one side of the plate, and at right-angles on the other. As is well known, wood is only affected by the absorption of moisture in its width—that is what is called the "width way" of the grain.

In about a week or so the pattern assumed a saucer shape, and neither by coaxing nor coercion could the plate be made to fit the flat bed prepared for it. Several 56-lb. weights were piled on each corner, with the object of forcing it down to the bed, but all to no avail. It was absolutely useless as an instrument or means for the production of flat plate castings. This plate-pattern cost probably £30. It was sold as scrap some time afterwards for 2s. 6d.

The main essentials of a pattern such as this is to produce a flat plate 8 ft. by 9 ft., whose


CORED POCKETS
SECTION ON CD
FIG 5
FIG 2- PLAN OF FRAME PATTERN WITH CORE PRINTS SHOWN IN SECTION
CORE PRINTS
BRACKET 'E' SQUARE CORNER FINISHED
FIG 4
FIG 3 SECTION A.B

panel is but $\frac{3}{4}$ in. thick. Obviously, a wooden plate of such an area and thickness, however hard the wood may be, is bound to sag and generally to take the shape of the surface upon which it rests. It is not sufficiently rigid in itself to remain true without support, even if it were perfectly true to commence with—and one has to depend upon the moulders striking a level bed upon which the pattern will be laid preparatory to the ramming-up process. Now, since moulders are obliged to depend upon this level bed to give the plate its correct surface shape, it must be clearly a complete dependence. That is to say, the pattern will not only not be expected to possess rigidity, but it must not be permitted to be rigid. And one must see to it that it is so constructed that it will not develop rigidity under any conceivable circumstances in which it may be placed in the foundry at any period of its existence. To the end of its days, in short, it must remain as passive as a pancake.

The two vital points, then, in this pattern, are material and construction, and if either of these two factors be neglected, it matters not how carefully the pattern is made in other respects, or how perfect may be its dimensions according to the contraction rule, it is bound to prove, sooner or later, a complete and perhaps very costly failure. The probability being, of course, that the first two or three trial castings will measure up correctly. The foundry will proceed full speed ahead, and the size of scrap heap will then depend upon the number of plates immediately on order and the time that elapses before they are required in the assembling department. As will have been gathered from what has been said, the plate is intended to be a standard pattern, that is, one which will be in constant use. This implies that

* A Paper read before the Birmingham Branch of the Institution of British Foundrymen, Mr. W. F. Flavell in the chair.

durability is another requisite to be secured if possible. "If possible" is said advisedly. Mahogany, for instance, is much harder and is consequently more durable than, say, yellow pine. Its very strength, however, fatally militates against its adoption in some situations. Where it is inclined to warp, especially if it has wide exposed surfaces, the absorption of moisture renders it absolutely uncontrollable. Pine will not wear so long, but by suitably arranging the grain, it may be kept true until it falls to pieces literally by senile decay.

Obviously the patternmaker is faced with this direct question:—

Is one to make a pattern of a material which is exceedingly hard and durable and which should allow of, say, 1,000 castings being made from it before it is scrapped, but which, on account of its inherent tendency to warp, may become quite useless before three castings have been made, or are we to use a lighter and milder material of less durability, but upon which we can absolutely rely for, say, 500 castings? Pattern-making is not gambling, and certainties are preferred. Pine, therefore, should be used for the body of the pattern, at any rate, because whatever may be its potential refractoriness as pine, one can, by certain methods of construction, keep it under perfect control.

### Best Construction Outlined.

As wood is not affected in the length way of its grain by moisture, it holds the key to the situation. The pattern will, therefore, be framed up in such a manner that the length way of the grain controls and guarantees the overall dimensions of the plate, both in width and length, and at the same time eliminates, or, at any rate, overcomes, any warping tendency that may be present. The ground work of the plate itself will be put together, as shown in Fig. 1.

The pine plate completed, ribs, facings, etc., are then added. For these mahogany should be used, as it will add considerably to the life of the pattern, and since the width of these mahogany trappings is comparatively small, the deleterious effect of any warping tendency on the part of any piece that is not locally nullified by a corresponding tendency on the part of an adjoining piece may be regarded as negligible. In a word, the most efficient use of the length way of the grain is made, since one can absolutely rely upon it, whilst reducing the width of every piece used to easily manageable dimensions.

The soundness of this method has been amply proved by experience. A plate was made in the manner outlined. It was in use for several years, and some hundreds of castings were produced from it, and when it was asserted that it was replaced by another made in exactly the same way, and that several other plates of varying sizes have since been similarly made, it will be agreed that it must have given all-round satisfaction.

Now the points touched upon, though essential in the construction of a pattern, especially such as the one dealt with, are somewhat elementary. That is to say, though an intimate acquaintance with the materials used in pattern-making and the ability to make the best use of those materials as an essential part of the business, it will not, by itself, carry one very far. It is merely the groundwork of the mechanical part of pattern-making. Pattern-making has been termed a "live art." Herbert Spencer defined life as "the continuous adjustment of internal relations to external relations." Pattern-making is, particularly in its advanced stages, according to Spencer's definition of life, indeed a live art.

The external relations to which it is vitally necessary for pattern-making to conform are the drawing office and the foundry. Other departments, of course, are more or less concerned, and there is also a very real economic aspect which must not be lost sight of. For we cannot afford to make every pattern of "Exhibition" quality.

What does this continuous adjustment to external relations really mean to the pattern-maker? It means, in the first place, that, through the medium of the blue print, one must obtain a perfectly clear mental grasp of the ultimate requirements of the designer. We must visualise the finished casting. Unless the job is an especially intricate one, this will be an almost instantaneous operation. The next consideration which follows closely, and which, by the way, is often decided in less time than it takes to put the question, is, "How best to mould the job?" Not "How is the pattern to be constructed?" This is a later consideration. For the pattern is but an instrument, and as such it must ever be subservient to the end it is required to serve.

In deciding upon the joints, cores, loose pieces, etc., the sole aim should be to reduce the job to its simplest possible terms, from the foundry point of view. Just as the finest writer or speaker is he who is best able to explain a difficult subject in simple terms, so the supreme test of a patternmaker undoubtedly lies in his ability to simplify a complicated moulding problem. For this implies not only the blue-print reading is a mere matter of A.B.C. to him, and that he has mastered the mechanical part of pattern-making, but it also argues a clear grasp of foundry requirements and

### Simplification of Patterns.

Simplicity, then, is the goal. In the quest for this desideratum one must bring the light of all one's experience, however remotely applicable it may be, to bear on the job from every conceivable angle. Every avenue must be explored in order to find the most direct or convenient route from the designer's idea to the actual casting itself. As the job varies, so must the methods vary accordingly. For a troublesome feature of design in one environment may often be made to serve a very useful purpose in another; that is, to simplify moulding. Finally, one should deal with an unworkable design as a wise statesman deals with an unworkable law—it must be altered, and fortunate is that foundry where the foreman patternmaker is encouraged to get alterations made in design in order to facilitate the production of castings and to make the moulder's lot, if possible, just a little more bearable.

Whilst examining a small weighbridge frame pattern several years ago it occurred to the author that it might easily be simplified with advantage to the foundry. It was one of the several sizes in constant use where even a slight improvement applied to the whole series might mean a great deal in the long run. Perhaps these rough sketches will enable me to make the job clear.

Fig. 2 shows a half-size section of one of Messrs. Avery's 4 ft. by 3 ft. 6 in. tram machine frame patterns. It contains five cored pockets opening on the inside of the frame, two in each end, close to the corners and one in the centre of one side. These pockets are identical with each other. They contain bearing brackets with cored slots for the reception of standard steel bars. The prints for these pocket cores are shown sectioned. The cores were made in a box as shown in Fig. 6, the slot cores being made from the small box (Fig. 7), and when dry were inserted in the print impressions left on the withdrawal of the loose pegs (F Fig. 6).

It occurred to the author that it would be a good thing for the moulder if the prints were removed. Obviously, the bits of sand (X Fig. 2) in the corners are very troublesome to the moulder. They require to be carefully rodded. Taking into consideration that the frames are about 12in. deep, it will be realised that there is a great risk of mould disturbance on the withdrawal of the pattern. Additionally there is a bevelled projecting edge running round the inside of the frame. As the pocket cores merely reached to the underneath side of the lip, though the prints extend, of course, to the top of the frame, the lip was required to be made up over each core. Consequently the casting sometimes came out very uneven round this edge.

It was considered that the bottom prints alone were quite sufficient to locate the cores, for they had a good base area, and they would rest against the inside face of the mould. The prints were removed. This directly secured two advantages. There was no further risk of the mould breaking down at the corners, and the time spent in guarding against this contingency was thus saved, and the internal lip required no making up. Here, again, time was saved, and a better casting was produced. Now, with the prints removed it was

seen that another point might be gained, but with the cores this time.

The brackets E, as will be noticed, are flush with the inside edge of the frame. By slightly altering the shape of these brackets—that is, making the corner square instead of round—an alteration that does not materially affect design—a core could be made in which the slot cores formed part and parcel of the main core. Two advantages were also gained here. The core was easier to make, and the outside dimension over the slots could, of course, be guaranteed. This was a very important point to gain, because the steel bars that were to be subsequently used in the slots were all one standard length, and they were required to fit accurately.

The job, as altered, proved to be an unqualified success. And the various size frames were similarly dealt with. Even now it cannot be said that the present method is the last word in the simplification of the job.

### Pattern Measurement.

This is the last operation performed on a pattern before it is sent to the foundry. Here, again, in the measuring-up of patterns, we have further support for saying that pattern-making is a live art. It seems to be a common belief, outside the pattern-shop and foundry, that, in order to measure a pattern, one has simply to take a contraction rule for the metal in which the casting is to be produced, and apply it to the job in the same way as one would measure, say, a mild-steel shaft that was being turned in the lathe. Now, as practical pattern-makers and foundrymen are aware, to their constant cost and annoyance, there never was a greater possible pitfall than this of implicitly trusting, with child-like faith, in the graduations of a contraction rule.

First, a contraction rule is a measuring instrument, whose graduations are longer than the ordinary rule by an amount that has been obtained from the average of repeated tests on the contraction of metal, to which it applies. Its business is with contraction alone—that is the point. It does not take rapping into account, not the shape of the casting, not the manner of moulding. Three unavoidable concomitants of foundry practice, which affect to a greater or less extent the size of the casting produced, and which are often of an equal and sometimes of greater importance than contraction itself. Since the real object of measuring a pattern is to ascertain the size of the casting which that pattern is likely to produce, is it not absurd to work strictly to the contraction rule, and to ignore these other factors? This is where a little knowledge of pattern-making, if not exactly dangerous, may prove, at times, to be a very costly thing.

During the war the author's firm obtained an order for several thousand mine sinkers. A cast-iron base was required on each. This base would be about 3 ft. sq. with a ¾ in. plate, and ribbed up to 5 in. deep. We received definite instructions to make a pattern to double contraction rule. The object was, of course, to make iron patterns. The rule was worked strictly to. Several iron patterns were made, then from these sample castings were produced. When the castings were measured up, however, they were found to be much too thick all over. The ¾ in. plate had grown to 1 in., and the ribs had similarly become stouter. The bases weighed over 5 cwts., instead of under 4 cwts.

Immediately it was stated that the pattern was wrong. The pattern was measured, and found correct in every dimension—that is, correct to double contraction rule. What had happened, of course, as may be expected, was that the plate parts had thickened up from the wooden pattern, to the iron pattern, then again from the iron patterns still more to the castings.

Not only do plates tend to thicken up, and thus give the lie to the contraction rule, but bulky parts of a casting may be relied upon, in some situations, to become bulkier.

Quite recently the author's attention was drawn to a casting that measured in depth, as moulded, 6 3/16 in. where the drawing showed 6 in. The pattern was found to measure 6 in. contraction rule. So far as the author's experience goes, castings do not contract so much vertically as horizontally—that is, as cast—or perhaps it would be more correct to say that there is not so much difference between the pattern and its casting when cast vertically, as there is when cast horizontally. In making crane barrels, it has been found that castings 2 and 3 ft. long come out as long as the pattern, when cast on end.

In these and similar cases the explanation probably is, that the mould is made larger, first by the pattern being rapped to facilitate its withdrawal, and, secondly, by the inability of the walls and floor of the mould to withstand the pressure induced by the great weight of the fluid metal. One can easily understand these containing walls of sand—especially if of green sand—giving way to a greater or less extent, however hard they may be rammed. Pattern measuring, then, is something more than the mere mechanical application of a contraction rule.

### DISCUSSION.

The President described the lecture as very interesting and instructive. Mr. Edwards had given them some very valuable hints with regard to pattern-making. As to the contraction rule, his (the President's) experience was that when a man went to a new firm he found the contraction in the castings varied to a certain extent, according to the kind of metal used. In the case of cylinders and other bodies cast on end, he found that there was no contraction at the bottom end. They get bigger, if anything. He had had some experience of big bodies of metal cast on end, and the strain was so great at the bottom that they used to keep under the size at that point. He was not quite so sure whether the remark applied equally to cylinders. It was necessary to ascertain from actual working whether the class of work engaged upon gave the same contractions and expansions as at other works. He agreed that to a certain extent the foreman pattern-maker had to leave some things to the men. Some pattern-making jobs in modern practice called upon a man for the highest intelligence. For instance, during the previous week he inspected a modern motor cylinder being cored up. There was only a matter of three-sixteenths of metal, with one complicated core being threaded into another one. There was no margin for a man to be out in his sizes. They had to be exact, and to do a job like that was a work of art.

MR. J. H. JOHNSON referred to the tendency of castings made on end to get larger at the bottom, and said he had always found that that could be largely eliminated if the moulder had a good riser from the bottom. It removed the strain. It was the strain on the metal which caused the growth, and that could be obviated by a riser right from the bottom. By that means they would obtain a casting that would be practically parallel all the way up.

MR. D. WILKINSON thought that for a permanent pattern the method shown by Mr. Edwards was sound. There was no question that it would be much more expensive, but the initial expense of a pattern that size must not be unduly considered. What had to be considered was length of life and service, and if it was effective, too much work could scarcely be put into it. He was interested to hear that, after a number of years, an improvement developed as a result of constant observation. It showed that one could never learn everything, and that however simple a job might look, and however satisfactorily it might be accomplished, improvement was always possible. One should not trust too much to routine in measuring up a casting. If one failed to take into account weight of metal on the sand, variations would occur. It certainly would not do to leave the contraction rule out, but commonsense must be used in measuring up a pattern. The quality of iron used would have a bearing on the result, and slight discrepancies must be taken into account. That was one of the inevitable difficulties of moulding. Nevertheless, it was astounding the accurate work that could be produced if systematic care was used and if the pattern-shop and foundry worked together, and if everyone concentrated upon producing a casting as close to the blue print as possible.

MR. B. KITCHIN agreed as to the advantages to be derived from co-operation between the various departments. Sometimes they had a design in

which thin metal was united to thick metal, which could have been avoided. His experience of contraction was that they had not only to bear in mind the contraction rule, but also the number of joints in the mould or pattern. For instance, an automobile cylinder, if cast on end, would exhibit four or five joints in the moulding box. They had to make the pattern first according to the contraction rule, and then cut out so much on the bottom joint, at the foot of the cylinder, to get the casting the proper size. All the joints in the mould had a tendency to grow, and in some instances castings came out $\frac{1}{8}$ in. thicker than the pattern.

Mr. E. H. Tyson said it was true that a cylinder with two or three joints did gain, and they often had to cut out contraction in a vertical automobile cylinder to ensure having the casting the proper length.

Replying upon the discussion, Mr. Edwards referred to the cost of the plate, remarking that if they had a plate which would last for seven or eight years, what did it matter if it cost an additional £5 or £10? A person who did not understand a pattern, and who had not had any experience of the contraction of castings, should be modest in the application of the contraction rule in the presence of a pattern-maker.

On the motion of Mr. J. H. Johnson, seconded by Mr. A. Parsons, Mr. Edwards was warmly thanked for his paper.

## Determination of Phosphorus in Pig Iron.*

### Volumetric Solution.

One or two grammes, depending upon whether the phosphorus content is above or below 0.15 per cent. of the sample, are transferred to an Erlenmeyer flask of 250 c.c. capacity, 40 to 50 c.c. of $HNO_3$ (sp. gr. 1.13) are added, and heat is applied until the sample is decomposed. Any material on the sides of the flask is washed into the solution by means of a jet of water, 1 gramme of ammonium persulphate is added, and the solution is boiled until the combined carbon is completely oxidised. The solution is filtered and the residue is washed with nitric acid (1:50) and hot water to the disappearance of the soluble iron. The filtrate is heated to boiling in a suitable flask, a slight excess of a solution of potassium permanganate is added, and the solution is boiled until the excess of permanganate is decomposed. A slight excess of a reducing solution is added to dissolve the precipitated manganese dioxide, and boiling is continued until the excess of the reducing agent is decomposed. The flask is removed from the heat, 50 c.c. of ammonium molybdate solution are added and the flask is shaken for five minutes. The yellow precipitate of ammonium phosphomolybdate, after settling, is collected on a 9 cm. filter paper and washed with $HNO_3$ (1:50) until free from iron solution and finally with a 1 per cent. sodium nitrate solution until free from acid.

The titration may be conducted in either a 250-c.c. beaker or the flask in which the precipitation was effected. If the former is used, care is exercised to remove any precipitate which adheres to the flask, while in the latter case the flask is washed thoroughly with sodium nitrate solution to completely remove the acid.

The filter paper and precipitate are transferred to the beaker or flask, and a measured excess of standard NaOH solution is added. In case the titration is conducted in a beaker, the filter paper is macerated with a glass rod; if conducted in a flask, a clean rubber stopper is inserted, and the contents are shaken vigorously until the paper is disintegrated and the dissolution of the precipitate is complete. The solution is diluted to approximately 100 c.c. with water free from carbon dioxide, and three drops of phenolphthalein solution are added, followed by standard nitric acid until the pink colour disappears. The sides of the vessel are washed with cold water, when the titration is completed by adding standard NaOH until the appearance of a permanent pink tint. The number of c.c.s. of the standard sodium hydroxide solution in excess over the standard acid used, multiplied by 0.02 or 0.01, depending upon the initial weight of the sample taken, is the equivalent of phosphorus in hundredths per cent.

*A method used and published by the United States Steel Corporation.

### Solutions Required.

*Standard Sodium Hydroxide Solution.*

| | |
|---|---|
| Sodium hydroxide ... | 6.6 grammes |
| Water ... ... ... | 1,000 c.c. |

*Standard Nitric Acid.*

| | |
|---|---|
| Concentrated nitric acid | 10 c.c. |
| Water ... ... ... | 990 c.c. |

The specified quantity of NaOH is dissolved in 500 c.c. of water in a one litre graduated flask. One c.c. of a saturated solution of BaOH is added, when the solution is diluted to the mark and mixed thoroughly. After standing for 12 hours or more, a portion of the clear solution is removed with a pipette for standardising. The acid and NaOH solutions are adjusted so that they exactly agree. They are then standardised by means of a steel of known phosphorus content and adjusted so that 1 c.c. is equivalent to 0.01 per cent. phosphorus based on an initial weight of 2 grammes of the sample. The NaOH solution is now filtered through a dry filter into a suitable container and thereafter protected from the air as much as possible.

*Phenolphthalein Indicator Solution.*

| | |
|---|---|
| Phenolphthalein ... ... | 1 gramme |
| Methyl or ethyl alcohol (neutral) ... ... | 1,000 c.c. |

*Nitric Acid (Sp. Gr. 1.13).*

| | |
|---|---|
| Concentrated nitric acid | 240 c.c. |
| Water ... ... ... | 760 c.c. |

*Potassium Permanganate Solution.*

| | |
|---|---|
| Potassium permanganate | 25 grammes |
| Water ... ... ... | 1,000 c.c. |

*Ammonium Molybdate Solution.*

| | |
|---|---|
| Molybdic acid (85 per cent.) ... ... ... | 65 grammes |
| Water ... ... ... | 142 c.c. |
| Concentrated ammonia ... | 143 c.c. |
| Nitric acid (sp. gr. 1.20) ... | 715 c.c. |

To the water in a suitable container is added the molybdic acid, followed by the ammonia. The contents of the vessel are shaken until the molybdic acid is dissolved, when the solution is cooled and poured slowly into the nitric acid, the latter being stirred constantly during the addition. To clarify the resultant solution, one drop of a 10 per cent. solution of ammonium phosphate is added. After agitation the solution is allowed to stand for 12 hours, when it is filtered, preferably by suction through an asbestos pad.

### Reducing Solutions.

*Ammonium Bisulphite Solution.*

5 per cent. solution.

*Ferrous Sulphate Solution.*

| | |
|---|---|
| Ferrous sulphate ... ... | 50 grammes |
| Sulphuric acid (1:1) ... | 50 c.c. |
| Water ... ... ... | 950 c.c. |

*Potassium Nitrite Solution.*

| | |
|---|---|
| Potassium nitrite ... ... | 50 grammes |
| Water ... ... ... | 1,000 c.c. |

*Sugar Solution.*

| | |
|---|---|
| Sugar ... ... ... | 500 grammes |
| Water ... ... ... | 1,000 c.c. |

This sugar solution should be added carefully, a drop at a time, in order to avoid an excess over the amount necessary to reduce the manganese dioxide. Three or four drops should be sufficient.

A MEETING of the Engineering and Shipbuilding Trades Federation and executive representatives of the Amalgamated Engineering Union, Foundry Workers' Union, and Workers' Union, was held at York last week. The Negotiating Committee, which met the railway managers recently on the wages question, submitted a report, and they were instructed to resume negotiations. The question of a working agreement being introduced to deal with working conditions arising in railway workshops was also considered, and the Committee were provided with a draft agreement for guidance in their further negotiations with the railway managers with the object of providing agreed regulations on all points which may arise on the questions of wages and working conditions.

# Apprenticeship and the Foundry Trades.*

By T. Makemson, Assoc. M.C.T. M.I.Brit.F.

(*Continued from Page 73.*)

### Training Schemes in Operation.

1. *Metropolitan-Vickers Electrical Company, Limited, Manchester.*

This Company has continuously in training:—(1) 700 apprentices and probationers to various engineering trades; (2) 88 college graduates. (College Apprentices); (3) 34 youths from public schools. (School Apprentices.)

Apprentices in groups 2 and 3 prepare during their works experience for employment of a technical or managerial character. The selection and training of all types of apprentices, together with other educational activities, is under the control of the Company's Education Department. This paper is concerned principally with the Trade Apprentice.

*Trade Apprentices.*—Apprenticeship commences between the ages of 14 and 16. The applicant is interviewed and is also required to pass a simple educational test. If successful, he enters the works as a probationer when a suitable vacancy occurs. At the end of a period of from three to twelve months his progress is reviewed, and if he is considered satisfactory he and his parent, together with representatives of the Company's management sign a moral agreement binding him as an apprentice until he reaches the age of 21 years. A medical examination takes place soon after the boy commences work, and his parents are notified of any physical defects which require attention.

The practical works training is carried out by a staff of apprentice instructors, each of whom is an experienced man at his own trade, and is also technically trained. A carefully prepared scheme of training is in operation for each trade. In trades which are specialised in different departments the boy is moved into each of these departments so that he may obtain experience in each branch of the trade.

All apprentices attend the Company's Works School for a period of from two to four hours per week in working hours, and without loss of pay. There is an organised course of instruction for each trade; there are also preparatory classes in which the instruction consists of a revision of the work performed in the day schools. All these classes are taught by the apprentice instructors. There are two school sessions per year. The trade instruction covers a period of six sessions or three years. The preparatory work covers two sessions; the total period spent in the works school is therefore normally four years. Selected apprentices who have finished their course attend a special drawing office class.

In addition to attending the works school, all boys are encouraged to undergo technical training at the recognised technical institutes, and every year the Company awards ten scholarships, each consisting of two years' attendance at the Monday day course at the Manchester College of Technology without loss of pay. The Company pays the fees and provides the necessary books. Vacancies in the drawing offices and other technical and commercial departments are to a large extent filled by promoting trade apprentices who have displayed outstanding ability in the workshops, the works school and in technical school work.

Apprentices in the foundry and pattern-making trades are trained under the general arrangements just outlined. Like most other employers, this Company has found that many of the apprentices in the foundry trades are below the average in general education. As a result of efforts which are being made, a better type of boy is, however, now entering the trade.

The scheme of training in schedule form has already been outlined in THE FOUNDRY TRADE JOURNAL.†

### Apprentice Association.

The social and athletic activities of the apprentices are controlled by the Apprentice Association, which includes the college and school apprentices also. The Association consists of the apprentices themselves, who appoint their own Council and officials. The Council acts also as a medium between the Company and the apprentices. Among its many activities is the publishing of a monthly magazine.

### Summary of Selected Training Schemes.

*C. & J. Weir, Glasgow.*—Apprentices pass an entrance examination in school subjects, and during their apprenticeship they attend voluntary day classes in trade subjects. In the first year, 160 hours' preliminary training is given for the purpose of revising the training given in the elementary schools.

*Mavor & Coulson, Glasgow.*—This firm employs apprentice instructors, one of whom is attached to the iron foundry.

*The British Thomson Houston Company, Rugby,* employs a supervisory staff, and a detailed scheme of transfers from one class of work to another is in operation. Considerable importance is attached to evening classes, and there is a system of bonuses for good work in the works and in the evening school.

*Davis Gas Stove Company, Luton.*—This company is engaged in the light castings trade; its training problem is therefore rather different from that of the engineering foundry. Learners are put under a working foreman, and as they become proficient at one class of work, they are moved on to other work.

### United States of America.

A number of schemes of various types designed to meet particular requirements are in operation in the United States.

*Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa., U.S.A.*—Trade apprenticeship commences between the ages of 16 and 19, and lasts four years. The first part of this period is spent in a special apprentice shop, under competent instructors or foremen. After passing into the regular shops, movement from one class of work to another is made in accordance with definite schedules. Four hours per week are spent in the works school. Instruction is given in mechanical drawing and in shop problems.

*Allis Chalmers Company, Milwaukee, Wis.*—Apprentices are indentured for four years, and during that time they are transferred from one class of work to another, according to a prepared programme. Five hours per week are spent in a day continuation school, which is a municipal institution.

*Worthington Pump & Machinery Corporation.*—This firm require a four-years' apprenticeship, the first six months of which is an "observation" period. The practical training is arranged according to a programme, and instruction, largely of a trade character, is given in the works school.

### Continental Schemes.

*Brown, Boveri & Company.*—This concern employs 350 apprentices. The apprentice is accepted after an interview, and upon his school record. After a period in a special apprentice department he is transferred to the foundry or other department appropriate to his chosen trade. Apprentice patternmakers spend a short period in the foundry. The Company conducts a works school, which apprentices attend instead of the State compulsory continuation school. The instruction is of a technical character, with some trade instruction.

*Messrs. Sultzer Bros.*—This firm has 620 apprentices in training. Apprentices spend 14 months in a special apprentice workshop, and are then transferred to the ordinary workshops. Five hours per week are spent in the Company's apprentice school.

* A Paper read before the Burnley Section of the Lancashire Branch of the Institution of British Foundrymen.

† See our issue of April 22, 1921.

*Osram Lamp Works.*—The works training is in charge of instructors. Apprentices attend the compulsory continuation school in the day time and the Technical High School in the evenings.

*Ludwig Loewe & Company.*—This famous firm has had a works school for a number of years. Trade instruction, and also instruction of a general character, is given. A systematic scheme of inter-departmental transfers is in operation in order to afford varied experience in shop work.

### How to Cater for Small Works.

It is frequently urged that only large and wealthy firms can afford to adopt the methods of apprentice training that have been described. Undoubtedly the larger firms have been first in the field, principally because their need is greatest. It is in the large and the medium-sized works where the apprentice is in danger of being overlooked; the smaller works, however, are adapting these schemes to their own requirements with satisfactory results.

No matter how small the number of apprentices in any department, the apprenticeship should be systematic. In a department with a minimum number of from 12 to 15 apprentices, it is a paying proposition to appoint an instructor to devote his whole time to their supervision and training.

The salary of such a man will be earned by the increased efficiency of the apprentices. With a smaller number of apprentices, a specific portion of the time of some competent person could be allocated to this duty.

School work can also be undertaken by the small works. The kind of instruction that is given in the evening schools is best left to the local education authority. It will, however, be found to be practicable and useful to give instruction on the following lines inside the works. A canteen or some other suitable room can generally be made available for a few hours daily.

There should be established revision classes in general school subjects. These classes would be attended by all the younger apprentices, irrespective of the trade they were following. Duration of class should be two hours per week. Additionally there should be a class for the older boys in each of the trades for which apprentices are trained, *i.e.*, a class for fitters, one for moulders and core makers, etc., the duration of each class being two hours per week.

If there were four trade classes in addition to the preparation class, the room would thus be in use for two hours per day on five days of the week.

### Teachers.

There should be little difficulty in arranging for the foreman or for a skilled workman to run the class relating to his own trade, and there is always at least one competent person in the smallest works who could arrange to spend two hours per week in conducting the preparatory class.

When a number of works are situated in the same town or district, it may be considered better for them to combine in the running of a joint school. Such a plan has much to commend it, and would enable classes to be conducted in those trades, such as patternmaking, where there may be only one or two apprentices in each works.

### Results.

In considering this kind of work, one naturally inquires, "Does it pay?" The answer is, "If a better type of workman is produced, then undoubtedly it does pay."

One naturally wonders whether this kind of training is producing a better type of workman. One remembers that moulders of the highest class were produced in the days when such elaborate training was unthought of; it it doubtful, however, whether the same result would be obtained by the same means to-day. The conditions under which many of the old-time workmen learnt their trade no longer exist, and it is difficult for a boy to secure the all-round training that is necessary unless special arrangements are made, and so, apart from the question of producing better workmen, some kind of scheme is necessary to ensure keeping up the supply of men as good as the old ones. The schemes which have been outlined simply do, in a systematic manner, what was previously done in the ordinary day's work. It is now no longer possible to perform these functions in the day's work, hence the necessity for devising other means of achieving the same result.

One result of such work is that the apprentice becomes more interested in his job. It is essential to get into the minds of our boys that they come to work to do something more than merely acquire the economic means to live. Their work is part of the actual living. They spend most of their waking moments at work, so they may as well get as much interest out of it as possible. There are so many distracting influences abroad to-day that it is not surprising to find that many boys look upon the day's work as an unnecessarily long and unpleasant preliminary to the evening's enjoyment. This state of affairs is responsible for much inefficiency, discontent, and unhappiness.

One fact stands out above all others in connection with the old-fashioned moulder; he was interested in his job. If the activities which have been described in this Paper do nothing more than awaken a similar interest in the minds of the present generation of apprentices, then they will have accomplished a good deal.

### Conclusions.

Some of the possible results may be considered in detail.

*More Efficient Workmen.*—The surest and most satisfactory method of obtaining a force of good workmen is for the employer to train them himself. A common criticism of this policy is that, when trained, the men are likely to leave and go elsewhere. This is not altogether borne out in practice. The fact that an employer has carefully trained and cared for his employees is one of the biggest factors in helping to retain them in his employ. It cultivates a spirit of loyalty, a spirit of attachment on the part of the employee, and as the competitor can offer no better terms than the present employer, there is obviously no inducement to the man to leave.

*The Apprentice Learns More Rapidly.*—It is generally understood that the money which an employer loses on an apprentice in his first year or two is only regained when the apprentice becomes profitable—that is, in the last two years of his apprenticeship. If systematic training is adopted, the lad wastes less time, and consequently becomes useful at an earlier age.

At least one Company well known to the author has retained a larger proportion of ex-apprentices since commencing its training schemes than was previously the case. Frequently a young fellow does leave some little time after completing his apprenticeship; he feels that he wants to move about a little, but a surprisingly large number of such men come back after a time and settle down with the Company.

*Benefit to the Worker.*—The worker undoubtedly stands to gain in that he becomes more capable; furthermore, such training has an educative and uplifting effect upon the man as distinct from the worker. It makes him more thoughtful, it gives him a wider view of his work, and it tends to make him a more desirable member of the community. Above all else, the interest of the boy is aroused, and if one does nothing more than this, then the work is worth while.

*Effect upon the Industry.*—The individual employer naturally considers the gain to himself and to his own employees, but the industry as a whole benefits by an improvement in the personnel at any one works. Training schemes are becoming more common, the pioneer firms have found the benefit of them, and other firms are following their lead.

In the foundry industry something must be done; the very life of the trade makes it imperative. The dearth of skilled men is notorious. (This, of course, does not refer to the abnormal period of bad trade through which we are now passing.) Boys must be obtained for foundries, and they must be given a training worth coming for. Given improved working conditions and improved training facilities, there is no reason why a better type of boy should not enter the industry. The status of the foundryman has improved enormously during the last few years, thanks almost entirely to the work of the Institution of British Foundrymen. It is necessary that some scheme of training be adopted, not only to continue the improvement, but to maintain the present standard. Whether

the foundry industry progresses or not depends very largely upon the class of boy entering, and upon how we train him when obtained.

The author wishes to thank The Metropolitan Vickers Electrical Company, Limited, Manchester, for permission to use much of the information contained in this Paper.

### DISCUSSION.

The CHAIRMAN said this was one of the best lectures on the subject to which he had the pleasure of listening, and, if time permitted, he could say a great deal on the points which Mr. Makemson had brought out. The systematic training of apprentices in the workshops would be a step in the right direction. Small shops as well as large ones would have to adopt it eventually. Unfortunately the grammar schools and the secondary schools had not been of much assistance to foundrymen in their educational efforts, but for the work done in the technical schools in evening classes he had nothing but praise. Especially was that so in the principal college at Burnley. His own experience convinced him of the value of evening classes. Where there were no day classes, where there was not at the works such a system as that described by Mr. Makemson, it was their duty as well as privilege to profit to the utmost extent by the evening continuation classes. He moved a vote of thanks to Mr. Makemson.

MR. PLACE, in seconding the vote of thanks, said an apprentice who was trained on the lines adopted at the Metropolitan Vickers works, would be one of the best workmen, an authority on his craft, one who took a pride in the position he held, and the work which he had to do.

MR. L. P. LAYFIELD said he did not agree with everything the author had said, for instance, with regard to deferring apprenticeship until 16, he thought the proposal would make it very difficult to get boys to train. At 14 years of age a boy might be willing to go into the foundry, but at 16 he wanted another sort of job, and unless the foundry was made more attractive than it was to-day, there would be a difficulty in getting apprentices. The scheme outlined by the author was a very fine one, and anyone who went through it would become, by the time he attained 21, a very good craftsman, and he would have a long start of the men in other places where no such training was given.

MR. PELL said, when he was in Dublin a few years ago, there was a proposal on foot that if a boy attended the technical school for two years, from 14 to 16, that time should be counted as part of his apprenticeship. In the days of his boyhood there were not the opportunities which were open to the lads of to-day, but he recollected there was a class for foundrymen at the Manchester Technical School, through which he supposed hundreds must have gone. He agreed with the idea of starting the apprenticeship at 16 if the previous two years were spent at a technical school.

The vote of thanks was passed unanimously.

In acknowledging the vote of thanks, Mr. Makemson said it was a vast subject and a good deal could be said on it from every point of view. In his opinion it would be wise to start the apprenticeship at 16, provided the boy had not been left to his own devices during the two years, but was attending a technical school. He would certainly be better able to understand his job. It was not his experience that boys trained in the way he described went off to another firm when it was over. The Metropolitan Vickers were retaining a greater proportion of their apprentices now than before they started the scheme. There was no inducement for a boy to leave a firm who had treated him fairly.

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ACCORDING to the British Commercial Agent of the Netherlands East Indies, there are openings for foundry products destined for use with the sugar refining industries. Detailed information can be had by applying to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1 (reference 9606/F.E./G.P.).

## The Lorraine Iron and Steel Problems.

According to Mr. A. Pawlowski, writing in a French contemporary on the Lorraine iron ore problem, the scarcity of labour immediately after the Armistice caused considerable anxiety to the mineowners in the Briey Basin. The departure of the Germans from the Moselle produced a lull at the mines, while the immigration of Italians decreased. French Governments have never troubled themselves about facilitating the influx of outside labour into Lorraine, and the restrictions placed on Italian emigration under M. Michelis turned a simple question into an affair of State. These considerations induced the Lorraine mineowners to make an appeal for Polish workers, but the East, and the Moselle in particular, are not disposed to encourage wholesale recruiting. Besides this, the Polish miner, although a good collier, has no experience in the mining of iron ore. And, on the other hand, the Polish immigration has not been on a scale as might have been expected. The proportion of Italians employed, therefore, remains relatively high, and that of the Poles small. Thus in 1921 there were only 342 Poles out of a total of 8,979 employed in the mines in the Moselle. In 1913 the Italians numbered 5,386 out of the total of 17,430, and the Germans 10,264. In 1921 there were 1,077 Germans and 3,917 Frenchmen, although many of the Germans became automatically naturalised, and are now counted as Frenchmen. On the other hand, the complete disappearance is noted of Belgians and Austrians formerly employed in the Moselle mines.

Concerning the Meurthe and Moselle, the Italian element here forms an essential part of mining labour, they numbering 2,988 out of a total of 7,236 in 1921, of whom 48.2 per cent. were foreigners. In the districts ceded to France to which workmen are attracted from other parts, including the mining districts, the workman is at liberty to work 10 or even 12 hours daily, whereas in the East, particularly in the Briey district, the miners' representatives strictly enforce the eight-hour working day. The scarcity of labour is naturally responsible for the reduced output, which is further affected by the decline in the efficiency of the workers in the Lorraine iron mines, as well as in the collieries. In view of these facts, the question arises as to how Lorraine will be able to produce 40,000,000 tons per annum, which was the quantity raised in 1913. In this connection a State official recently expressed the opinion that it would be impossible to recruit a sufficient number of men for the purpose, if the eight-hour day is to be upheld. The owners of the iron mines, however, are less pessimistic. The reconstruction of the war-damaged regions will sooner or later come to an end, and it will then be possible to attract the Italians; and German workmen will also return to the Moselle when France and Germany have buried the hatchet. In addition, an improvement in the equipment and a better organisation of working are under consideration, including the granting of premiums to encourage individual production. The trials already made in this direction have been encouraging.

The author's second contribution discusses the question of the supply of motive power and inter-urban transport problems, while the third deals with exports and the carriage of ore and iron and steel products. The author states that the production of 40,000,000 tons of Lorraine ores (Briey, Longwy and Moselle) implies appropriate means of transport and of tariffs adapted to the requirements of the consuming industries. After pointing out the deficiencies in the former respect, the author states that there is only one speedy solution of the problem. This is the proposed canalisation of the River Moselle up to Thionville, for which purpose industrialists in the Moselle have recently offered to advance to the Government the sum of 77,000,000 fcs. to carry out the scheme.

The Lorraine producers, who have organised their sales, formed an ore association in 1919 which obtained good results in Belgium, but it is hampered in regard to Great Britain by high transport costs.

# An Apprenticeship Course in Foundry Practice.—XXIX.

By Ben Shaw and James Edgar.

## LOAM MOULDING.

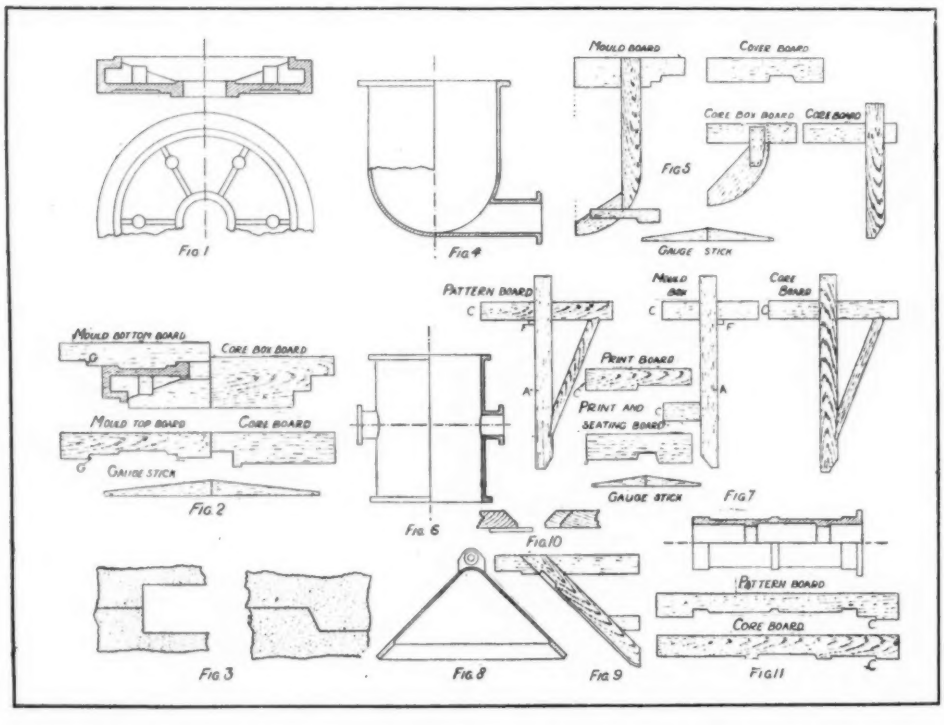
### Part II.

So much work that is done in loam depends upon sweeping boards that some consideration must be given to their preparation when dealing with loam moulding. One of the important advantages of loam is the facility with which it can be swept or strickled and given a shape defined by the profile of the sweeping board or strickle, and therefore the making of boards forms a very important part of the work. These sweeping boards are the work of the patternmaker. Not only is he solely responsible for making them, but frequently for the manner in which they are made; it follows, therefore, that unless the patternmaker has a sound knowledge of the principles involved in the sweeping of loam work he is incapable of providing suitable boards to meet the requirements of the work. It is the fundamental principles that the patternmaker should be conversant with, otherwise his training is incomplete and his qualifications as a skilled craftsman are proportionately reduced. Different methods of building similar classes of work prevail in different districts, but the patternmaker with the requisite fundamental knowledge can readily adapt himself to the methods, or to those adopted by the foundry likely to do the work. We have previously suggested the advisability of collaborating with the foundry executive before preparing a pattern for unfamiliar work; this advice is of special importance when loam work is involved, particularly when the work is out of the ordinary run, or when a foundry, other than the usual foundry, has secured the order for the castings. Greater familiarity with drawings frequently gives the patternmaker the advantage of determining how a job should be made, but co-operation between the departments enables the work to progress more smoothly and, as a rule, the work is more efficiently done.

Many patternmakers have an intense dislike to the preparation of pattern work for loam moulding, as it invariably means a reduction in the amount of work that would otherwise be necessary for a sand mould. We believe, however, that the economical production of castings is the concern of the patternmaker as well as the moulder, and the method likely to give suitable results at the lowest costs is the most economical.

#### Sweeping or Striking Boards.

Profiled edged boards may be classified under three headings, viz: vertical sweeping boards, horizontal sweeping boards, and strickles. The boards used for sweeping work in a vertical direction are fixed at a definite distance from a vertical spindle and either rotated with or about it to define the shape to be struck up. The boards used for sweeping work in a horizontal direction rest upon racks or trestles which support a spindle on which the loam work is to be done. They are set so that their working edges are at the required distance from the centre of the spindle and held in position by weights. In the latter case it will be noted that the rotating spindle carries the loam and the board is temporarily fixed. The term strickle is applied to a wide variety of profiled edged boards, but it generally refers to boards that are controlled and operated by hand rather than to those that are temporarily fixed. For the purpose of this article we will confine ourselves to sweeping boards and discuss strickles when skeleton patternmaking is under consideration.




#### Sweeping Board Construction.

Sweeping boards are usually made of yellow pine, varying in thickness from ⅜-in. when comparatively small, to 1½ in. for the largest of work. Small projections from the working edge are frequently formed from hardwood let into the main part of the board, or strips may be secured to the face of the board projecting from the working edge the desired amount. Boards that are to be used many times should have their profiled edges supported with hoop iron, as the wood is subject to considerable wear during the operation of sweeping. For work in steel particularly, boards

are frequently supported with hoop iron when they are only to be used once. When the contour of the work to be swept varies and is determined from the same centre, the board may be cut to the larger or smaller shape, according to whether the work is to be swept inside or outside, and a temporary piece secured to the face of the board to determine the shape of the other part. The working edges of all sweeping boards are chamfered on one side, leaving the profiled edge about ¼-in. or 5/16-in. thick. With vertical sweeping boards some difference of opinion exists as to which side of the board should be chamfered. Some moulders prefer drawing the board with the left hand, leaving the right hand free to manipulate the loam, others prefer working the reverse way, and known as sweeping clockwise. The chamfer desired is easily determined from the shop practice. The board is revolved with the chamfer in advance of the working edge. Boards should be so constructed that when secured to a vertical spindle they are rigid. This is not difficult to secure when internal sweeping is required, then two spiders may be used to fix the board if the work is high, but for external sweeping it is difficult to construct a board that will be rigid for high work. A framed board, or one having a stiffening stay, is necessary in such instances. The cross piece defining the top of the work should be half lapped to the vertical board, and it should be carried to or past the centre of the work it represents in order that it can be cut to fit against the spindle. The width of material suitable for these boards should not exceed 6 in.

**Shape of boards requires checking.**

Boards that are to be used for horizontal sweeping are supported at each end, and they are liable to sag in the centre under the weight of loam they carry when the work is being swept. This weakness must be prevented as much as possible, particularly with long boards. It is not necessary to use material thicker than 1½ in., but a long batten about 3 in. or 4 in. wide and 1½ in. thick secured to the top surface of the board and in a vertical direction will give considerable support; it is, however, necessary to support such boards from the foundry floor when in use, otherwise there would be a continual vertical movement during the time of sweeping. It is particularly important that the board should maintain the shape given to it along its working edge, and wood that is not straight-grained is unsuitable, it being more liable to twist on absorbing moisture from the wet loam. A long board should be checked immediately before it is to be used in the foundry to ascertain whether the wood has changed its form.

**Typical examples.**

In order to assist the apprentice in the making of sweeping boards, some typical examples have been chosen that are invariably made in loam, and they will be found applicable to a wide range of work for which loam boards are required.

Fig. 1 shows a section and part plan of a centralising ring required in cast iron. Rarely is more than one casting required to one size and design, and, as the outside diameter may be up to about 7 or 8 ft., sweeping the mould is an economical way of producing a casting. Four sweeping boards, one gauge stick and six ribs with bosses attached cover the pattern work involved. The mould is conveniently made in the reverse position to that shown in the sectional drawing, Fig. 1; and, as this form of mould favours sweeping about a vertical spindle, the boards should be carried to the centre, unless the diameter of spindle to be used is known when half the diameter can be cut from them in order that they will fit against the spindle.

Two boards are necessary to sweep the mould, of these the bottom board is the main board. In all work of this character it is better to form as much of the mould as possible with the bottom board, so that the cover-plate can depend upon gaggers only for carrying the loam that is to define the top shape. It is customary to show a half section of the required casting on the face of the bottom board, similar to that illustrated in Fig. 2, for the moulders' guidance. It will be noticed that the board shown carries a print for the core, this need only be about 1 in. or 1¼ in. deep, because it is only necessary to locate the core. A guide is cut from the board at G and a corresponding projection on the top board; these will provide a fitting joint illustrated by the enlarged sketch, Fig. 3. In some districts the "feeler" joint is preferred, also shown in Fig. 3, this would necessitate projections on both boards. The boards necessary for the core are shown in Fig. 2. These consist of a core-box board, with which a temporary core-box can be swept out, and a core board which determines the shape of that part of the core projecting from the temporay box. A gauge should always be supplied with work of this kind for checking the boards when fixed to the vertical spindle. It should be cut to the outside diameter and notched to represent the metal thickness so that it can be used for the core-box board.

**Suction Chamber Castings.**

Another example of the same form of sweeping, but varied to suit the suction chamber casting shown in Fig. 4, is done by means of the boards shown in Fig. 5. Again, four boards and a gauge stick are necessary, and pattern work is required for the branch. The mould or cope board, as it is sometimes called, follows the contour of the outside of the required casting and fitting from the centre. The flange is swept out and also a guide for locating the cover. Because of the branch, a joint along its horizontal centre is advisable, and in order to provide a guide or seating a temporary piece of hardwood is attached to the board as shown. The bearance formed by this projecting piece is used for locating the branch, and the guide is formed about it by hand-joining that which has been swept. Some prefer two boards when a point of this nature is necessary, but the full board as illustrated is better. The core must be secured to the cover plate, therefore the cover board should be made to form a print to receive it. This board then sweeps out a print and also a guide corresponding to that on the mould board. Cores that cannot be conveniently handled should be made to correspond with the position they occupy in their moulds; thus, in this instance, it is necessary to sweep out a part core-box to form the spherical end of the core. For this purpose a core-box board is necessary, and the remaining part of the core is formed with the board shown in Fig. 5. The core board is extended to include the print thickness.

For cylinders (Fig. 6) where the diameter is large compared to the length, one of two methods is adopted. Either a loam pattern is prepared to which subsidiary pattern work, such as the flanges and branches, is attached and the mould made in dry sand or loam, or the mould is swept out on the same principle as that previously explained. The form of pattern board necessary is shown in Fig. 7. The projection at F merely cuts out a recess upon which wood segments representing the flange can rest, and a fine projection at A will define the centre line on which the branches can be set.

For sweeping a mould the top flange at F can be swept out and a wood flange is only necessary for the bottom, the form of the mould board being shown in Fig. 7. It is customary to lift a mould so formed from its bottom plate to facilitate cleaning and blacking, therefore some form of seating or guide is required. This seating can be swept out when sweeping the print, and a board similar to that shown in Fig. 7 is suitable for the purpose. The core board is usually made the full length of the core, including the print, and this is necessary when a loam pattern is used and the mould is made in dry sand; but when a loam mould is used, the core is generally built in the print impression and the core board is then made the correct height of the core.

Sometimes a thickness of loam representing the thickness of metal in the required casting is swept on the mould forming a box in which the core can be made. This method is suitable for the bell casting shown in Fig. 8. It is not necessary to make two boards, but to prepare one board so that its working edge conforms to the inside shape of the casting and to make up the edge so that it represents the outer shape, as in Fig. 9. A thickness similar to the thickness of metal may

be fitted on the edge or hardwood may be secured to the face of the board, both methods being shown in Fig. 10. A guide should be cut from the board, but no cover board is necessary because the cover is made on the mould.

The loam work involved in horizontal sweeping consists in the making of loam patterns in addition to cores. Thus in the example shown in Fig. 11 the whole pattern, excepting the flange, which is more conveniently made in wood, can be swept. For this purpose the pattern board illustrated is suitable, it being made long enough to provide prints and to have a bearance on the trestles. It is convenient to cut off the length of print at C and to make a corresponding stop C on the core board so that the core can be accurately located. Both pattern and core boards should have gauge sticks secured to them on the upper surfaces, and near to the diameters they represent, or the sizes may be cut into the boards to allow callipers to be set from them. The thickness of metal should always be shown on the core board for work of this kind.

## The Operation of Small Side Blown Converters.*

By MONS. T. LEVOZ.

The small, side-blown converter was severely criticised from the first and one of the early patterns, in 1888, was denounced by the Bessemer enthusiasts as "an excellent producer of iron-oxide"! This condemnation, however, was unjust, because it was proved that the cost of re-lining these converters was very little greater than would have been the case with the bottom-blown type. The experimental results obtained from a one-ton surface blown converter were fully confirmed when a 5-ton vessel was used. The same mixture was used as in an adjoining bottom-blown converter, molten metal being used in both cases. With side blowing very hot metal was obtained in 12 minutes, and 20 per cent. of scrap could be used as against only 10 per cent. by the ordinary Bessemer. A test piece analysing 0.325 per cent. carbon, 0.70 per cent. manganese, gave an ult-tensile strength of 42 tons per sq. in., with an elongation of 18 per cent. on 4 in. For producing these ingots the charge was 78 per cent. hematite iron, more than 20 per cent. scrap, and 2 per cent. additions. For castings the output was as follows: Good castings 60.0, foundry scrap and wasters 11.0, runners and risers 15.0, remainder cast in ingots 1.0, and cupola and converter losses 13.0 per cent. The average weight of the castings was 26 lbs.

A report comparing the latest type ("Levoz") with one of the early patterns ("Robert") showed great improvements. The duration of the "blow" was 6 or 7 minutes, compared with 12 to 13 in the "Robert" type. The metal produced was very hot and fluid, and of altogether better quality than that made from the same mixture in the ordinary Bessemer. The refractory lining showed little sign of wear and tear and could run for weeks without serious repairs. Table I. shows the mechanical results obtained.

*Table I.—Mechanical results obtained from Levoz converter steels.*

| Cast No. | Analysis. C. | Mn. | Si. | P | S | Mechanical Tests. Ult. ten. Str. Tons sq. in. | Elastic limit sq. in. | Elongation on 4 in. per cent. |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.086 | 0.30 | 0.05 | 0.05 | 0.04 | 22.2 | 18.1 | 34 |
| 2 | 0.125 | 0.35 | 0.105 | 0.06 | 0.05 | 27.3 | 18.4 | 30 |
| 3 | 0.260 | 0.77 | 0.112 | 0.05 | 0.06 | 33.0 | 20.6 | 25 |
| 4 | 0.370 | 0.98 | 0.118 | 0.06 | 0.05 | 40.6 | 26.0 | 20 |
| 5 | 0.410 | 1.25 | 0.120 | 0.06 | 0.06 | 55.2 | 34. | 16 |
| 6 | 0.310 | 0.40 | 0.115 | 0.05 | 0.05 | 31.7 | 19.8 | 25 |
| 7 | 0.445 | 0.63 | 0.125 | 0.05 | 0.05 | 50.2 | 26.8 | 14 |
| 8 | 0.510 | 0.78 | 0.130 | 0.06 | 0.05 | 56.0 | 31.7 | 11 |

The "Levoz" pattern of these small converters also enables hard steels to be produced; owing to the high temperature and fluidity of the charge it is able to absorb carbon in almost any form without appearing as graphitic carbon in the finished metal.

One reason for the adverse criticism of small, side-blown converters was the abortive attempt, by Tropenas, to introduce a new method of working. Briefly, the idea was to have two rows of tuyeres, of which the lower would, by blowing across the surface of the charge, bring about the oxidation of the combustible elements in the iron, Si., Mn., and C. The air supplied by the upper row was to convert the CO produced in the above process to $CO_2$. This was obviously impossible. However, a thorough trial was given with a freshly-lined converter properly dried and brought up to a white heat before the addition of the molten iron. A very hot, fluid metal and liquid slag resulted, but the addition of carbon caused a violent reaction, and torrents of sparks were ejected, leading to a loss of 20 per cent. The tuyeres were badly burned after 13 heats. A further attempt was made with much better results. In this case the charge was made up exactly as before with regard to the proportions of iron and scrap and subsequent additions, but the blowing was different. The blast was directed across the surface until the beginning of the conversion; then, as the flame became yellower—after the shower of sparks denoting the burning of the silicon—the converter was gradually brought to the upright position until, at the end of the "blow," the surface of the bath was about 2 in. above the tuyeres. Under these conditions the flame and general appearance of the operation was very much like that of an ordinary Bessemer converter. The metal obtained was very hot and fluid, and retained its fluidity much longer than in the preceding experiment. A very compact slag was formed, and there was little burning of the tuyeres. The combined loss in cupola and converter was 13 per cent. It was noticed that, although the metal in the second case was run into the moulds at a higher temperature than the first, the castings could be freed from sand more easily; annealing could be carried out at a lower temperature and the castings were easy to machine. Moreover, certain blackish particles—insoluble in nitric acid, sp. gr. 1.2—that were abundant in the metal from the first experiment were absent in that from the second.

### Steel Scrap is utilised.

During the war these small, side-blown converters were successfully worked with as much as 70 per cent. of scrap. Synthetic cast-iron, too, has been successfully used in this apparatus, using 10 to 25 per cent. ferro-silicon and 80 to 85 per cent. scrap. Cast-iron and steel turnings briquetted with resin and coke dust have been satisfactorily worked. Still later experiments have shown that it is possible to cast both steel and iron directly from iron-ore.

An important point in the plant for this process is that the cupola for feeding the converter with molten iron should be of ample capacity, so that the operation of the converter may be regular and the metal homogeneous. It is essential that the iron should be run into the converter at a high temperature. A suitable composition for the iron should not exceed the following: Si. 1.5 per cent., Mn. 0.70 per cent., and total C. 3.0 per cent. richer metals lead to waste in conversion without improving fluidity or quality.

The question of air supply has been the subject of many experiments, and, for a 1 to 1½-ton converter excellent results have been obtained from 4 tuyeres about 1¼-in. dia. and an air pressure from 5 to 11 lbs. per sq. in. A good average is, tuyeres 1 in. dia., air pressure 6 lbs. per sq. in. At the beginning of the "blow" sparks issue from the mouth of the converter; the moment that a red flame appears, the body is tilted so as to raise the level of the bath by ½ to 1 in. with relation to the tuyeres. When the flame is white, the body is tilted until the tuyeres are covered. This finishes the combustion of the silicon and decarbonisation begins, at which point the bath level must be brought to about 1½ in. above the air ports. By degrees the body is brought up to the vertical position.

It is obvious that there are a great many variable factors in the operation of this apparatus, but ultimate success depends upon a meticulous attention to detail.

*Extracted from a Paper presented to the Association Technique de Fonderie.

THE LATE MR. R. GREENHALGH, of Atherton, Lancs., retired engineer, left £22,248.

## Trade Talk.

THE PALMER SHIPBUILDING AND IRON COMPANY, LIMITED, Jarrow and Hebburn, have decided to re-start two of their blast furnaces on hematite.

MR. A. EGERTON KIDNER has removed from 32, Queen Victoria Street, E.C.4, to Windsor House, Victoria Street, Westminster, London, S.W.1.

THE VALLEY ENGINEERING COMPANY, of Rastrick, Halifax, are closing down their business, the plant and machinery of which are to be sold by auction.

THE YARLSIDE IRON ORE MINES belonging to the Barrow Hematite Steel Company, Limited, and which have been closed for nearly two years, have been restarted.

THE NEGOTIATIONS for the amalgamation of the Industrial League and Council and the National Alliance of Employers and Employed have been abandoned.

OSBOURNE, GRAHAM & COMPANY, of Hylton, have secured orders for two small steamers, one to carry 1,600 tons and the other to carry 2,500 tons. Both will be engined on the Wear.

FERGUSON, PAILIN, LIMITED, electrical switchgear manufacturers, of Manchester, have appointed Mr. F. Thorp to succeed Mr. J. H. Sandiford as London engineer at their offices at 37, Norfolk Street, Strand, W.C.2.

MR. R. LOWNDES, secretary of the Midland Iron and Steel Wages Board, states that the wages regulated by the sliding scale under the Board will be reduced $2\frac{1}{2}$ per cent. from Monday, February 5, to Saturday, April 7.

MR. J. FRED KINCHIN, Russell Road, Hall Green, Birmingham, formerly representing Alley & McLellan, Limited, Glasgow, has been appointed representative for the Midlands of Peter Brotherhood, Limited, Peterborough.

PROFESSOR F. C. THOMPSON lectured on "The Heat Treatment of Non-Ferrous Alloys" at a meeting of the Sheffield section of the Institute of Metals, held at the Applied Science Department, Sheffield University, on January 25.

THE STEEL COMPANY OF SCOTLAND, LIMITED, have started up at their Blochairn Works, Glasgow, a large new rolling mill, which has been specially erected for the rolling of ship plates for the Clyde shipbuilding companies interested in the steel company.

SIR ARCHIBALD ROSS presided at a meeting of the North-East Coast Institution of Engineers and Shipbuilders, held in Newcastle on January 28, to discuss the seven papers on different types of marine-internal-combustion engines which were read on January 12.

BEFORE the members of the Sheffield Association of Metallurgists and Metallurgical Chemists, in Sheffield, on January 30, Professor W. E. S. Turner, of the Sheffield University, delivered an interesting lecture on the subject of "Some Problems Common to the Study of Glass and Metals."

MR. H. DEAN gave a paper on "Metals used in Engineering" on January 27 at the Neville Hall, Newcastle, before a gathering of members of the graduate sections of the North-East Coast Institution of Engineers and the Associates' and Students' Sections of the North of England Institute of Mining and Mechanical Engineers.

FOLLOWING UPON the action of the Federation of British Industries in addressing a letter to the Prime Minister urging the importance of placing public contracts in the United Kingdom, the British Empire Producers' organisation has written to the President of the Board of Trade requesting the latter to receive, at as early a date in February as is convenient, if possible before the opening of Parliament, a deputation on this most vital subject.

THE ANNUAL DINNER of the South Wales Branch of the Institution of Mechanical Engineers was held at Swansea on January 24, when there was a company of about 100, including the president, Dr. Hele-Shaw. Mr. D. E. Roberts was in the chair, and those present included Messrs. J. W. Burr, J. Butler, F. H. Chivers, W. O. Dayson, F. Bacon, Paul Cocks, W. Johnson, F. W. Gilbertson, F. Taylor, U. Williams, C. T. Allan and I. Evans.

THE NOMINATING COMMITTEE of the American Foundrymen's Association have made the following nominations for the various offices for the ensuing periods:— President (one year), Mr. G. H. Clamar, Ajax Metal Company, Philadelphia, Pa.; vice-president (one year), Mr. H. B. Swan, Cadillac Motor Car Company, Detroit, Mich.; directors (three year terms), Mr. L. L. Anthes, Anthes Foundry, Limited, Toronto, Ont.; Mr. T. S. Hammond, Whiting Corporation, Harvey, Ill.; Mr. Alfred E. Howell, Somerville Stove Works, Somerville, N.J.; Mr. C. R. Messinger, Chain Belt Company, Milwaukee, Wis.; Mr. Thos. W. Pangborn, Pangborn Corporation, Hagerstown, Md.

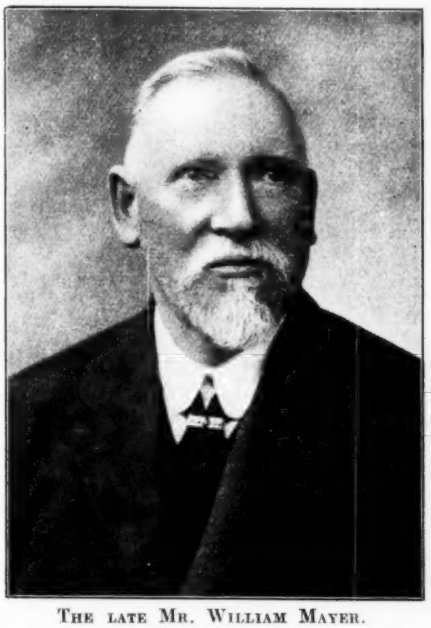
## John Surtees Examination.

The Governors of the above fund announce that as the result of the recent examinations, the following foundry apprentices have been awarded prizes:—

*First Prize.—Silver Medal.*—Thomas Golder, 7, Orange Street, South Shields. Employed at Messrs. C. W. Taylor and Sons, Limited, South Shields.

*Second Prize.*—J. Watson, Northumberland Street, North Shields. Employed at The Wallsend Slipway and Engineering Company, Limited.

*Third Prize.*—J. E. Harle, 162, South Palmerston Street, South Shields. Employed at Messrs. C. W. Taylor and Sons, Limited.



THE LATE MR. WILLIAM MAYER.

Mr. Mayer is a Past President of British Foundrymen (1915). He gave the Presidential Chain of Office to the Institution, and the funds for the provision of the Surtees Medal to the Scottish and Newcastle Branches of the Institution.

It will be remembered that the necessary funds for this work have been provided by the late Mr. William Mayer, a past president of the Institution of British Foundrymen, to perpetuate the memory of the late John Surtees, who introduced and developed the art of dry-sand moulding on Tyneside.

## British Industries Fair.

### Birmingham Section.

Foundrymen will find much of interest for them at the Birmingham Section of the British Industries Fair, which is to be held at the Castle Bromwich Aerodrome from February 19 to March 3. We notice that the Drop Forgings Association are to exhibit, and foundrymen would do well to examine this exhibit carefully, as many objects now being manufactured by drop-forging previously came within the domain of the foundry.

Testing and weighing machines, and foundry equipment generally, will form an interesting section, whilst in general engineering there will be much to interest him. A few actual foundries themselves are also showing.

**The Ruhr Invasion and Newfoundland Iron Mines.**—A cable from Sydney (N.S.) states that the Wabana iron mines in Newfoundland have suspended operations owing to the cancellation by Herr Stinnes of German contracts, due to the Ruhr invasion. Some 2,500 miners have been thrown out of work, and the most prosperous period in the history of the district has been temporarily ended.

# IRON AND STEEL MARKETS.

## Pig-iron.

**MIDDLESBROUGH.**—Due to the recent pressure of demand, the position in the Cleveland iron market has now become extremely difficult, stocks of all qualities of pig being practically exhausted, with the result that buying for prompt delivery is almost impossible at the moment. Consequently, prices all round have marked a sharp advance, conditions inevitable in face of the great excess of demand over supply, while the make of most qualities of pig at the moment is practically stationary, a position likely to continue while fuel costs remain at present levels. The immediate effect on the home trade has been to check the volume of inquiry, except in the case of consumers who have delayed purchases in the hope of obtaining cheaper terms and now find themselves unable to obtain their requirements, even at the higher prices now ruling. Quotations therefore may be regarded as almost nominal, as follow:—No. 1 (out of stock entirely), 110s.; No. 3 G.M.B., 105s. for February-April delivery; No. 4 foundry, 100s.; and No. 4 forge, round about 90s. With regard to the export trade the course of events on the Continent is certainly influencing an increase in the volume of inquiry from abroad. Users in Italy, Scandinavia and elsewhere are finding it increasingly difficult to get delivery of the cheap iron contracted for in Germany, and are consequently falling back upon the British producer. More business in this direction may, therefore, be looked for, though it will certainly be checked to some extent by the advance in prices.

Business in hematite iron continues to show healthy expansion, and it is probably being further stimulated by the disproportionate rise in Cleveland pig-iron. The home trade is strong and active, and the situation on the Continent is bringing a better export inquiry. Quotations are advancing. At Tuesday's market 105s. was named for East Coast mixed numbers, with the usual premium of 6d. per ton on the No. 1 quality.

**MANCHESTER.**—The general tendency to advance pig-iron prices has also affected the Lancashire markets, and although one or two makers of Derbyshire No. 3 are still quoting on a basis of 85s. per ton f.o.t., others are asking more. Fortunately a good many Manchester and South Lancashire ironfounders had bought for delivery up to March early in the year, and some as far back as December, when the prices were about equal to 90s. per ton delivered in Manchester. This buying now enables them to hold back and wait in the expectation that the present prices will be reduced before they need to come into the market again. In Manchester 118s. 6d. and sometimes 122s. 6d. per ton is wanted for No. 3 Scotch foundry iron, but very few ironfounders are able or willing to pay so much. As a consequence the trade here in Scotch iron continues to fall away, although there are, of course, some founders who will have it, no matter what the cost.

**THE MIDLANDS.**—Business in pig-iron in this district has become increasingly difficult, and forward buying especially is greatly restricted by the reluctance of smelters to entertain commitments on future account until the position is much clearer defined than at the present time. There can be no doubt, however, that were conditions normal the number of furnaces in blast in this district would be increased. There is a much improved demand for iron, and some of the South Staffordshire makers are of opinion that the time has arrived when, from this point of view, they could safely put their furnaces into blast again, but the fuel situation makes them hesitate. Coke is abnormally dear. There is not much inquiry for prompt delivery. Consumers appear to have covered current requirements, but many of them seem to be feeling the market with reference to the future. So far they do not find smelters very responsive.

**SCOTLAND.**—The Glasgow market for pig-iron has been active, and prices have further advanced. No. 3 being quoted at over 100s. per ton at the furnace. As previously mentioned, the Scotch makers are anxious to keep their quotations at a moderate level, but it seems as if they would have considerable difficulty in adhering to this policy in view of the prices being asked and paid for Middlesbrough iron. Business was actually done last week in No. 3 Middlesbrough at 107s. 6d. to 110s. delivered Lanarkshire points, whilst No. 3 Scotch is obtainable at 5s. to 7s. 6d. per ton less. In view of such a position it may be regarded as certain that Scotch ironmasters will be forced, in self-protection, to ask still higher prices.

## Finished Iron.

In this section of the market there has been a distinct improvement in the outlook since the opening of the year, and unemployment in mills, forges and foundries in South Staffordshire has now been reduced to a substantial extent, though, unfortunately, there are still many works still operating short-handed. Makers of marked bars are steadily employed, and there is a more sustained demand for the better qualities of crown bars, which during a considerable part of last year were so difficult to sell. Makers whose brands have always been in specially good repute are now fully employed, and have enough orders on their books to keep them busy until the end of the month. In such cases the quotation is now £11 10s. works and is very firm. Secondary qualities are firm at the 5s. advance. Makers are finding some difficulty in keeping the mills going satisfactorily, owing to the scarcity and dearness of piling scrap. Fencing iron is up to about £10 12s. 6d., and nut and bolt bars to about £10 7s. 6d. The Lancashire quotation for both these rules 2s. 6d. higher.

## Scrap.

Reports from all centres of the scrap metal trade confirm recent accounts of a steady improvement both in demand and prices, the extreme scarcity of pig-iron doubtless explaining the increasing firmness of the various markets. Buyers are consequently coming forward more freely, but are finding supplies comparatively scarce. This is evidently the case at Middlesbrough, where supplies of steel scrap are very restricted, and deliveries of cast-iron turnings and borings are also limited. Prices all round show a substantial advance, the following being approximate quotations, delivered works: Heavy steel scrap, 82s. 6d.; cast-iron machinery metal, 87s. 6d. to 90s.; steel turnings and c.i. borings reach 65s.; heavy wrought-iron piling scrap, 77s. 6d. to 80s.; specially selected heavy forge scrap, 90s. to 92s. 6d. per ton.

## Steel.

Expansion in most departments of the steel trade continues satisfactory, and more recently, doubtless, has been considerably accelerated by the course of political events on the Continent, the dislocation of German industries having diverted some substantial orders for material and constructional work which otherwise would have gone abroad. It is also reported that a contract for 100,000 tons of steel rails and sleepers has been placed with home manufacturers, while other important orders are pending in connection with the construction of a new railway to the Belgian Congo. These evidences of increased activity have had, of course, a corresponding effect upon the market for alloys, in which ferro-manganese is in good demand at full prices, the export price having been raised to the level of the home trade. A rather less active interest is taken in ferro-silicon at the moment, and prices remain unchanged. A Continental inquiry for 100 tons is noted, and a smaller one for low-silicon content for home consumption. In silico-manganese some interest is displayed, and a nice order has been placed round about £15 10s. for 50 per cent. Mn. content during the week. Prices are firming up in semi-products, both acid and basic billets being freely bought. Sheffield prices are: Siemens acid billets, £11; hard basic billets, £9 5s.; medium, £9; soft ditto, £7 15s. to £8; soft basic wire rods, £10 to £10 10s.; bright steel bars, £15; steel hoops, £12. The tone of the tinplate market continues very firm, with practically all works asking an advance on the official minimum selling price. Most mills are now fully engaged for at least two to three months ahead. Quotations for the basis sizes are as follows: Coke finish, IC, 14 by 20, 112 sheets, 108 lb., 21s. to 21s. 6d. per box; IC, 28 by 20, 56 sheets, 108 lb., 21s. 6d. to 22s. per box; with lights at ¾d. per lb. reduction, crosses at 3s. 9d. extra for first cross, then 3s. 3d. rise each cross, net cash, f.o.b. Bristol Channel. If f.o.b. London delivery 1s. basis extra, and f.o.b. Liverpool 9d. basis extra. If delivery is taken on rails at makers' works 3d. per box basis reduction.

## Metals.

**Copper.**—Messrs. Henry Bath & Son, Ltd., in their fortnightly metal report state:—There is a decided improvement in the demand from home consumers and

(*Continued on page* 126.)

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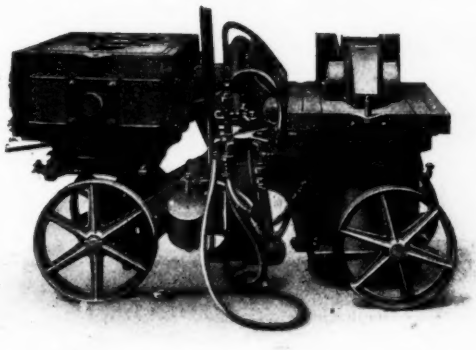

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**IRON AND STEEL MARKETS,**—*Continued.*

prices of refined copper have advanced. The American market is firm with an improved demand for the metal and a further expansion is anticipated. It is interesting to note that whereas at the close of the war the world's stock of copper was approximately 1,139,000 tons (of 2,000 lbs.) the present stock is said not to exceed 385,000 tons, less than three months' supply at the present rate of consumption. Current quotations :—*Cash* : Wednesday, £65 7s. 6d. ; Thursday, £65 12s. 6d. ; Friday, £65 5s. ; Monday, £65 5s. ; Tuesday, £65 5s. *Three Months* : Wednesday, £66 ; Thursday, £66 5s. ; Friday, £65 17s. 6d. ; Monday, £65 17s. 6d. ; Tuesday, £65 17s. 6d.

**Tin.**—This market has displayed great activity and prices during the fortnight marked a substantial advance. From £180 10s. cash and £182 three months' values rose almost without a break, finally touching £187 5s. cash and £188 15s. three months by the 30th ult. In this market also a reaction followed, resulting in a depreciation in values of about £3 per ton. America continues a good buyer with spot metal in limited supply and commanding a premium. Home consumers are still fairly busy, but very little business is passing with the Continent. The Straits shipments for January are advised as about 6,100 tons, and the U.S. deliveries as about 6,600 tons. Current quotations :—*Cash* : Wednesday, £184 ; Thursday £183 17s. 6d. ; Friday, £183 2s. 6d. ; Monday, £182 17s. 6d. ; Tuesday, £183 12s. 6d. *Three Months* : Wednesday, £185 10s. ; Thursday, £183 17s. 6d. ; Friday, £184 15s. ; Monday, £184 17s. 6d. ; Tuesday, £185 12s. 6d.

**Spelter.**—In this market also the highest prices touched were on the 30th ult., viz., £37 5s. January and £35 10s. April, while values receded about 7s. 6d. per ton. Consumption in this country is good, and may easily increase as time goes on. Supplies from European sources are not likely to be augmented, but American production is developing largely and a fair quantity of this metal is already finding its way to this market, which rather proves that consumption in U.S. is barely keeping pace with production. Current quotations :—*Ordinary* : Wednesday, £36 17s. 6d. ; Thursday, £35 17s. 6d. ; Friday, £35 5s. ; Monday, £35 ; Tuesday, £35 2s. 6d.

**Lead.**—This market, as in the case of copper and tin, experienced a sharp advance which culminated on the 30th ult., when business took place up to £28 17s. 6d. per ton for near delivery. Consumption of the metal in the United States is said to be so heavy that Mexican lead is now being used on a larger scale, so that there is every prospect of supplies from that quarter for this market being considerably curtailed in future, while there is still no evidence of increased production in other centres. Current quotations : *Soft foreign (prompt)* : Wednesday, £28 5s. ; Thursday, £28 5s. ; Friday, £28 ; Monday, £28 2s. 6d. ; Tuesday, £28 2s. 6d.

## Gazette.

MR. E. WILLIAMS, trading as the Birmingham Waste Trade Company, 36a, Bristol Street, and residing at 119, Carlton Road, Birmingham, scrap metal merchant, has been adjudicated bankrupt. Exam., C.C., Birmingham, March 21, at 2.30.

TRADING under the style of J. Emmott & Company, Messrs. J. Emmott and J. S. Beaumont, Thornton Street, Collyhurst, Manchester, ironfounders, have dissolved partnership. Debts by Mr. J. Emmott, who continues the business.

TRADING under the style of B. Briggs & Sons, Messrs. T. Briggs, B. Briggs and J. K. Briggs, 6, Bessbrook Street and Church Street, Leeds, iron and steel merchants, have dissolved partnership. Debts by Mr. B. Briggs, who continues the business.

## Deaths.

MR. C. L. FAULKNER, a director of Bolling & Lowe, Limited, iron and steel merchants, 2, Laurence Pountney Hill, London, E.C.4, died on January 20 in his 55th year. Some years ago he was in business on his own account, representing several well-known Belgian iron and steel concerns, returning to Messrs. Bolling & Lowe about five years ago.

THE HON. RICHARD CLERE PARSONS, the distinguished engineer, died on January 26 at his residence in Princes Gardens, South Kensington. Mr. Parsons, who was in his seventy-second year, was the fifth son of the third Earl of Rosse, the eminent astronomer. In his early years he was a partner in Kitson & Company, of Leeds, and during his stay there took a practical interest in the development of what is now Leeds University. He was later in partnership with Mr. J. F. La Trobe Bateman.

## Company News.

**J. E. Reeve, Limited.**—Capital £6,000. Engineers and dealers in machinery, etc.

**Dalmellington Iron Company, Limited.**—Interim ordinary dividend, 6d. per share, free of tax.

**Monkbridge Iron and Steel Company, Limited.**—Preference dividend for the year postponed.

**J. H. Hilton & Company, Limited,** 198, Chapel Street, Leigh, Lancs.—Capital £1,500. Engineers.

**Greenwood & Batley, Limited.**—Interim dividend on preference, 3½ per cent. ; ditto ordinary, 2½ per cent.

**Signode, Limited.**—Capital £5,000 in £1 shares. Metal workers. Directors: J. H. Chapman and W. J. Yeoman.

**Walter Bennett, Limited.**—Capital £2,000. Electricians, mechanical engineers, etc. Directors: W. Bennett (secretary) and D. W. Lockhead.

**Carlton Engineering Company, Limited,** 68½, Bloomfield Road, Plumstead, London, S.E.—Capital £3,000. Directors: C. W. Tarrant, F. T. Sleeman and H. Cynes.

**T. J. Sowerbutts & Son, Limited,** 300, Whalley Range, Blackburn.—Capital £8,000. Manufacturing mill furnishers. Directors : T. J. Sowerbutts and W. T. Sowerbutts.

**Gerald Engineering Company, Limited,** 7, New Square, Lincoln's Inn, London, W.C.—Capital £2,500 in £1 shares. Directors: E. T. Woodbridge and W. E. Hartoff.

**Burntisland Shipbuilding Company, Limited.** — Balance on trading for year, £1,456; brought forward, £5,980; total, £7,436; ordinary dividend passed; carried forward, £7,436.

**Cary, Hallewell & Company, Limited,** New Era Engineering Works, Brentford Road, Willesden, London, N.W.—Capital £2,500 in £1 shares. Engineers. Directors: A. L. Cary, W. Hallewell, and E. L. Stacey.

**De Laval Chadburn Company, Limited,** Wellington House, Buckingham Gate, London, S.W.1.—Capital £35,000 in £1 shares. Centrifugal separators. Directors: W. R. Chadburn, H. H. McColl and H. Johnstone.

**Consett Iron Company, Limited.**—Accounts will, in future, be made up to March 31, instead of June 30, in each year. Next accounts will, therefore, be for nine months ending March 31 next. No interim dividend paid now.

**Research & Development Company, Limited,** 25, Bedford Street, Strand, London, W.C.2.—Capital £5,500 in 5,000 10 per cent. ordinary shares of £1 and 10,000 deferred shares of 1s. Civil, mechanical, general and electrical engineers, manufacturers of patent fuels, etc. Director: A. T. Hurter (permanent). Secretary: W. T. Gittens.

## Personal.

THE LATE MR. G. M. BOWEN, of Woodsetton, Coseley, Staffs., crucible and fire brick manufacturer, left £12,581.

MR. J. W. KIRKLAND, previously managing director of the South African General Electric Company, has been appointed London manager of the International General Electric Company, New York.

MR. J. ELLIS, a past-president of the Institution of British Foundrymen, has accepted a position with the Cardiff Foundry and Engineering Company, Limited, Hunnan Street, Cardiff.

MR. R. EVERITT, founder and chairman of Everitt & Company, Limited, 40, Chapel Street, Liverpool, and Walbrook, London, E.C., and a director of the Cardiff Hematite Iron Ore Company, Limited, who died on April 2, left £116,048, with net personalty £115,388.

MR. F. J. TAYLOR, chairman of the Welsh Engineers and Founders' Association, has been the recipient of a presentation from the members of the Association in recognition of his services. Tributes were made to the ability, zeal and genial character of Mr. Taylor, who, up to 1918, acted as hon. secretary since the start of the organisation.

MR. J. S. RITCHIE has relinquished his position as assistant commercial manager at the Birkenhead works of Cammell, Laird & Company, Limited, and has accepted an appointment as representative for England, Wales, and Ireland of Messrs. Parker & Company, boat builders, whose yard is at Sandbank, on the Clyde. Mr. Ritchie has opened an office in Preeson's Row, Liverpool, from which his new business, which includes other agencies, will be conducted.

MESSRS. LAWSON, WALTON & COMPANY, LIMITED, 2, St. Nicholas Buildings, Newcastle-on-Tyne, have been appointed the sole representatives on the Tyne and Wear area for the well-known "Necol Plastic Wood." Large stocks will be held in Newcastle.

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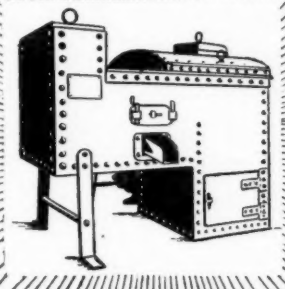
**Heat 1.**
Charging of metal finished 17 Cwt. 3 qrs. 12 lbs.
Ready to tip (after 55 mins. from start).
**Heat 2.**
Charging of metal finished 11 Cwt. 3 qrs. 18 lbs.
Ready to tip (after 45 min. from start).
424 lbs. Coke for 3620 lbs. metal.
1 lb. Coke to 8½ lbs. metal.



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| | £ s. d. |
|---|---|
| Standard cash | 65 5 0 |
| Three months | 65 17 6 |
| Electrolytic | 72 0 0 |
| Tough | 69 10 0 |
| Best selected | 69 10 0 |
| Sheets | 98 0 0 |
| India | 84 10 0 |
| Wire bars | 72 12 6 |
| Do. Feb. | 72 12 6 |
| Do. Mar. | 72 12 6 |
| Ingot bars | 72 10 0 |
| H.C. wire rods | 77 0 0 |
| Off. aver., cash, Jan. | 34 11 1 7/11 |
| Do. 3 mths., Jan. | 65 3 9 |
| Do. Settlement Jan. | 64 11 0 3/11 |
| Do. Electro, Jan. | 71 10 10 10/11 |
| Do. B.S., Jan. | 69 2 2 2/3 |
| Aver. spot price, copper, Jan. | 64 9 10½ |
| Do. Electro, Jan. | 73 13 7½ |
| Solid drawn tubes | 13¾d. |
| Brazed tubes | 13¾d. |
| Wire | 10¾d. |
| Yellow metal rods | 7d. |
| Do. 4x4 Squares | 8½d. |
| Do. 4x3 Sheets | 9½d. |

## BRASS.

| | |
|---|---|
| Solid drawn tubes | 12d. |
| Brazed tubes | 13½d. |
| Rods, drawn | 10¾d. |
| Rods, extruded or rolled | 6¾d. |
| Sheets to 10 w.g. | 10¼d. |
| Wire | 10¼d. |
| Rolled metal | 9¾d. |

## TIN.

| | £ s. d. |
|---|---|
| Standard cash | 183 12 6 |
| Three months | 185 12 6 |
| English | 183 10 0 |
| Bars | 185 10 0 |
| Chinese | 181 12 6 |
| Straits | 186 10 0 |
| Australian | 185 7 6 |
| Eastern | 188 15 0 |
| Banca | 185 7 6 |
| Off. aver., cash, Jan. | 181 18 6 2/11 |
| Do. 3 mths., Jan. | 183 9 5 19/32 |
| Do. Sttlment, Jan. | 181 18 4 10/11 |
| Aver., spot, Jan. | 181 17 0½ |

## SPELTER.

| | £ s. d. |
|---|---|
| Ordinary | 35 2 6 |
| Remelted | 33 0 0 |
| Hard | 28 0 0 |
| Electro 99.9 | 40 0 0 |
| English | 36 10 0 |
| India | 29 0 0 |
| Prime Western | 36 10 0 |
| Zinc dust | 49 10 0 |
| Zinc ashes | 13 0 0 |
| Off. aver., Jan. | 34 16 8 35/44 |
| Aver., spot, Jan. | 35 14 8 |

## LEAD.

| | £ s. d. |
|---|---|
| Soft foreign ppt | 28 2 6 |
| English | 29 5 0 |
| Off. average, Jan. | 26 18 6 3/11 |
| Average, spot, Jan. | 27 2 4½ |

## ZINC SHEETS, &c.

| | £ s. d. |
|---|---|
| Zinc sheets, English | 44 0 0 |
| Do. V.M. ex whf. | 41 0 0 |
| Dutch | 42 0 0 |
| Rods | 49 0 0 |
| Boiler plates | 41 0 0 |
| Battery plates | 42 0 0 |

## ANTIMONY.

| | £ s. d. |
|---|---|
| English regulus | 27 10 0 |
| Special brands | 33 10 0 |
| Chinese | 24 10 0 |
| Crude | 18 0 0 |

## QUICKSILVER.

| | £ s. d. |
|---|---|
| Quicksilver | 10 10 0 |

## FERRO-ALLOYS AND STEEL-MAKING METALS.

| | £ s. d. |
|---|---|
| Ferro-silicon— | |
| 45/50% | 11 17 6 |
| 75% | 20 0 0 |
| Ferro-vanadium— 35/40% | 17/- lb. va. |
| Ferro-molybdenum— 70/75% c. free | 9/3 lb. mo. |
| Ferro-titanium— 23/25%, carbonless | 1/1½ lb. |
| Ferro-phosphorus, 20/23%, £23 | |
| Ferro-tungsten— 80/85%, carbon free | 1/5 lb. |
| Tungsten metal powder— 98/99% | 1/10½ lb. |
| Ferro-chrome— 4/6% car. | £21 10 |
| 6/8% car. | £20 10 |
| 8/10% car. | £20 0 |
| Ferro-chrome— Max. 2% car. | £54 0 |
| Max. 1% car. | £65 0 |
| Max. 0.70% car. | £73 0 |
| 67/70%, carbonless | 1/6½ lb. |
| Nickel—99%, cubes or pellets | £130 0 |
| Cobalt metal—98/99% | 11/3 lb. |
| Aluminium—98/99% | £95 |
| Metallic Chromium— 96/98% | 4/6 lb. |
| Ferro-manganese (net)— 76/80%, loose | £15 |
| 76/80%, packed | £16 |
| 76/80%, export | £15 |
| Metallic manganese— 94/96%, carbonless | 2/2 lb. |

Per ton unless otherwise stated.

## HIGH-SPEED TOOL STEEL.

| | |
|---|---|
| Finished bars, 14% tungsten | s. d. 2 6 |
| Finished bars, 18% tungsten | 3 0 |

Per lb. net, d/d buyers' works.

Extras—
- Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
- Rounds and squares under ½ in. to ¼ in. 3d. lb.
- Flats under 1 in. by ⅜ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
- Bevels of approved sizes and sections 6d. lb.
- If in coils 3d. lb.
- Packing £3 ton.
- Bars cut to length 10% extra

Scrap from high-speed tool steel—
- Scrap pieces 3d.
- Turnings and swarf 1d.

Per lb. net, d/d steel makers' works.

## SCRAP.

| South Wales— | £ s. d. | £ s. d. |
|---|---|---|
| Heavy steel | 4 5 0 | 4 10 0 |
| Bundled steel & shearings | 3 15 0 | 4 5 0 |
| Mixed iron & steel | 3 17 0 | 4 2 6 |
| Heavy cast iron | | 4 0 0 |
| Good machinery for foundries | 4 5 0 | 4 10 0 |

| Cleveland— | £ s. d. |
|---|---|
| Heavy steel | 4 2 6 |
| Steel turnings | 3 5 0 |
| Cast-iron borings | 3 5 0 |
| Heavy forge | 4 11 3 |
| Bushelled scrap | 3 17 6 |
| Cast-iron scrap | 4 7 6 |

| Lancashire— | £ s. d. |
|---|---|
| Cast-iron scrap | 4 3 9 |
| Heavy wrought | 3 18 9 |
| Steel turnings | 2 15 0 |

| London— | £ s. d. |
|---|---|
| Copper (clean) | 58 0 0 |
| Brass (clean) | 34 0 0 |
| Lead (less usual draft) | 24 0 0 |
| Tea lead | 20 0 0 |
| Zinc | 24 10 0 |
| New aluminium cuttings | 64 0 0 |
| Braziery copper | 49 0 0 |
| Gun metal | 44 0 0 |
| Hollow pewter | 150 0 0 |
| Shaped black pewter | 90 0 0 |

Above are merchants' buying prices delivered yard.

## PIG-IRON.

| | |
|---|---|
| N. E. Coast— | |
| Foundry No. 1 | 110/- |
| Foundry No. 3 | 105/- |
| Forge No. 4 | 90/- |
| Mottled | 87/6 |
| Hematite No. 1 | 105/6 |
| Hematite M/Nos. | 105/- |
| Midlands— | |
| Staffs. common | — |
| ,, part-mine forge | — |
| ,, ,, foundry | — |
| ,, Cold blast, ord. | 200/- |
| ,, ,, roll iron | 210/- |
| ,, basic | — |
| Northants forge | 77/6 |
| ,, foundry No. 3 | 85/- |
| ,, basic | — |
| Derbyshire forge | 82/6 |
| ,, foundry No. 3 | 90/- |
| ,, basic | — |
| Scotland— | |
| Foundry No. 1 | 106/-to107/6 |
| ,, No. 3 | 101/-to102/6 |
| Hematite M/Nos. | 107/6 |
| Sheffield (d/d district)— | |
| Derby forge | — |
| ,, foundry No. 3 | — |
| Lincs. forge | 86/6 |
| ,, foundry No. 3 | 87/6 |
| ,, basic | 90/- |
| E.C. hematite | 110/3 |
| W.C. hematite | 112/6 |
| All d/d in the district. | |
| Lancashire (d/d eq. Man.) | — |
| Derby forge | — |
| ,, foundry No. 3 | 100/- |
| Northants foundry No. 3 | — |
| Cleveland foundry No. 3 | — |
| Staffs. foundry No. 3 | — |
| Lincs. forge | — |
| ,, foundry No. 3 | 100/- |
| Summerlee foundry | 118/6 |
| Glengarnock foundry | 118/6 |
| Gartsherrie foundry | 118/6 |
| Monkland foundry | 118/6 |

## FINISHED IRON & STEEL.

*Usual District deliveries for iron; delivered consumers' station for steel.*

| Iron— | £ s. d. |
|---|---|
| Bars (cr.) | £10 10 to 11 10 0 |
| Angles | £10 15 to 11 15 0 |
| Tees to 3 united ins. | 11 10 0 |
| Nut and bolt | 10 7 6 |
| Hoops | 15 0 0 |
| Marked bars (Staffs.) | 13 10 0 |
| Gas strip | £10/15 to £11 |
| Bolts and nuts, ¾ in. × 4 in. | 16 10 0 |

| Steel— | £ s. d. |
|---|---|
| Ship plates | £9 5/-to 10 0 0 |
| Boiler plates | £12/10 to £13 |
| Chequer plates | 10 5 0 |
| Angles | £9 5 0 to 9 15 0 |
| Tees | £9 12 6 to 10 0 0 |
| Channels | 9 5 0 |
| Joists | 9 0 0 |
| Rounds & squares 3 in. to 5½ in. | 11 0 0 |
| Rounds under 3 in. to ⅝ in. | 10 15 0 |
| Flats, over 5 in. wide and up | 11 5 0 |
| Flats, 5 in. to 1½ in. | 10 10 0 |
| Rails, heavy | 9 0 0 |
| Fishplates | 13 0 0 |
| Hoops | 11 10 0 |
| Black sheets, 24 g. | 12 15 0 |
| Galv. cor. sheets, 24 g. | 18 10 0 |
| Galv. fencing wire, 8 g. plain | 16 0 0 |
| Rivets, ¾ in. dia. | 12 5 0 |
| Billets, soft | 7 2 6 to 8 0 0 |
| Billets, hard | 8 2 6 to 8 15 0 |
| Sheet bars | 7 12 6 to 7 15 0 |
| Tin bars | 8 1 0 |

## PHOSPHOR BRONZE.

| | Per lb. basis. |
|---|---|
| Strip | 1 3¼ |
| Sheet | 1 4 |
| Wire | 1 4 |
| Rods | 1 2¾ |
| Tubes | 1 6¼ |
| Castings | 1 1¼ |

Delivery 3 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

## NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

| | Per lb. |
|---|---|
| Ingots for raising | 9d. to 1/3 |
| Rolled— | |
| To 9 in. wide | 1/3 to 1/9 |
| To 12 in. wide | 1/3¼ to 1/9¼ |
| To 15 in. wide | 1/4 to 1/10 |
| To 18 in. wide | 1/4¾ to 1/10¾ |
| To 21 in. wide | 1/5½ to 1/11½ |
| To 25 in. wide | 1/6¼ to 2/0¼ |
| Ingots for spoons and forks | 9d. to 1/3 |
| Ingots rolled to spoon size | 1/- to 1/6 |
| Wire round— 3/0 to 10 G. | 1/6½ to 2/1½ |

with extras according to gauge

## AMERICAN IRON & STEEL.

| At Pittsburgh unless otherwise stated. | Dols. |
|---|---|
| No. 2X foundry, Phila. | 29.76 |
| No. 2 foundry, Valley | 27.00 |
| No. 2 foundry, Birm. | 24.00 |
| Basic | 27.96 |
| Bessemer | 29.27 |
| Malleable | 28.96 |
| Grey forge | 28.27 |
| Ferro-manganese 80% delivered | 107.50 |
| Bess. rails, h'y, at mill | 43.00 |
| O.-h. rails, h'y, at mill | 43.00 |
| Bess. billets | 37.50 |
| O.-h. billets | 37.50 |
| O.-h. sheet bars | 37.50 |
| Wire rods | 47.50 |
| | Cents. |
| Iron bars, Phila. | 2.47 |
| Steel bars | 2.10 |
| Tank plates | 2.10 |
| Beams, etc. | 2.10 |
| Skelp, grooved steel | 2.00 |
| Skelp, sheared steel | 2.00 |
| Steel hoops | 2.75 |
| Sheets, black, No. 28 | 3.35 |
| Sheets, galv., No. 28 | 4.35 |
| Sheets, blue an'l'd, 9&10 | 2.50 |
| Wire nails | 2.70 |
| Plain wire | 2.45 |
| Barbed wire, galv. | 3.35 |
| Tinplate, 100-lb. box | $4.75 |

## COKE (at ovens).

| | |
|---|---|
| Welsh foundry | 37/6 to 42/6 |
| ,, furnace | 25/- to 27/6 |
| Durham & North. fdy. | 32/6 |
| ,, furnace | 28/6 |
| Other Districts, foundry | 32/6 |
| ,, furnace | 26/6 |

### SWEDISH IRON.

Bars, hammered basis sizes—Basis price £22 to £23

Rolled Ordinary—
Assortment ..
Nail Rods—
Square, round and flats .. } £ s. d. 16 10 0 to 17 5 0

Keg Steel nom. £38 to £40

Faggot Steel nom. £30 to £32

Blooms—
Single welded .. £10 to £11

Billets—
Single and double welded .. .. £13 to £14

Pig-iron—
Grey, white or mottled £6 10 to £7 5 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

### TUBES.

Up to and incl. 6 in.

Gas .. ..57½% } Tube prices
Water ..52½% } are
Steam ..47½% } now free.

### TINPLATES.

| | | |
|---|---|---|
| f.o.b. Bristol Channel ports. | | |
| I.C.Cokes, | 20×14, box | 21/3 |
| ,, | 28×20, ,, | 43/6 |
| ,, | 20×10, ,, | 30/9 |
| ,, | 18¾×14, ,, | 21/9 |
| I.X. | ,, | 47/6 |
| I.X.X. | ,, | 53/6 |
| F.C.B.Y. | 21×13⅝ ,, | 39/6 |
| C.V.B.G. | 16¾×15, ,, | 37/6 |
| I.C.W. | 20×14, ,, | 19/3 |
| ,, | 28×20, ,, | 38/– |
| ,, | 20×10, ,, | 27/3 |
| ,, | 18¾×14, ,, | 20/– |
| Ternes. f.o.t. | 28×20, ,, | 42/– |

### DAILY FLUCTUATIONS.

**Standard Copper** (cash).

| | | £ | s. | d. | | |
|---|---|---|---|---|---|---|
| Jan. | 31 | 65 | 7 | 6 | dec. | 10/– |
| Feb. | 1 | 65 | 12 | 6 | inc. | 5/– |
| ,, | 2 | 65 | 5 | 0 | dec. | 7/6 |
| ,, | 5 | 65 | 5 | 0 | No change | |
| ,, | 6 | 65 | 5 | 0 | ,, | |

**Electrolytic Copper.**

| | | | | | | |
|---|---|---|---|---|---|---|
| Jan. | 31 | 72 | 5 | 0 | dec. | 15/– |
| Feb. | 1 | 72 | 5 | 0 | No change | |
| ,, | 2 | 72 | 5 | 0 | ,, | |
| ,, | 5 | 72 | 0 | 0 | dec. | 5/– |
| ,, | 6 | 72 | 0 | 0 | No change | |

**Standard Tin** (cash).

| | | | | | | |
|---|---|---|---|---|---|---|
| Jan. | 31 | 184 | 0 | 0 | dec. | 45/– |
| Feb. | 1 | 183 | 17 | 6 | ,, | 2/6 |
| ,, | 2 | 183 | 2 | 6 | ,, | 15/– |
| ,, | 5 | 182 | 17 | 6 | ,, | 5/– |
| ,, | 6 | 183 | 12 | 6 | inc. | 15/– |

**Tin** (English ingots).

| | | | | | | |
|---|---|---|---|---|---|---|
| Jan. | 31 | 184 | 0 | 0 | dec. | 45/– |
| Feb. | 1 | 184 | 0 | 0 | No change | |
| ,, | 2 | 183 | 0 | 0 | dec. | 20/– |
| ,, | 5 | 183 | 0 | 0 | No change | |
| ,, | 6 | 183 | 10 | 0 | inc. | 10/– |

**Zinc Sheets** (English).

| | | | | | |
|---|---|---|---|---|---|
| Jan. | 31 | 44 | 0 | 0 | No change |
| Feb. | 1 | 44 | 0 | 0 | ,, |
| ,, | 2 | 44 | 0 | 0 | ,, |
| ,, | 5 | 44 | 0 | 0 | ,, |
| ,, | 6 | 44 | 0 | 0 | ,, |

**Spelter** (ordinary).

| | | | | | | |
|---|---|---|---|---|---|---|
| Jan. | 31 | 36 | 17 | 6 | dec. | 7/6 |
| Feb. | 1 | 35 | 17 | 6 | ,, | 20/– |
| ,, | 2 | 35 | 5 | 0 | ,, | 12/6 |
| ,, | 5 | 35 | 0 | 0 | ,, | 5/– |
| ,, | 6 | 35 | 2 | 6 | inc. | 2/6 |

**Lead** (English).

| | | | | | | |
|---|---|---|---|---|---|---|
| Jan. | 31 | 29 | 10 | 0 | dec. | 5/– |
| Feb. | 1 | 29 | 10 | 0 | No change | |
| ,, | 2 | 29 | 5 | 0 | dec. | 5/– |
| ,, | 5 | 29 | 5 | 0 | No change | |
| ,, | 6 | 29 | 5 | 0 | ,, | |


There's something for You among these —

Blacking, Coal Dust, Plumbago, Charcoal, Core Gum, Terra Flake, Gannister, Core Oils, Sea Sand, Moulding Sand, Iron Cement, Brushes, Bellows, Buckets, Chaplets, Core Ropes, Core Tapers, Ladles, Crucibles, Cupolas, Riddles, Sprigs, Spades, Carborundum Bricks and Wheels, Ferro-Aluminium, Blacking Bags, Foundry Plant, Etc., Etc., Etc.

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## PATENTS.

INVENTORS Advice, Handbook and Consultations Free. KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Regd. Patent Agent, 146a, Queen Victoria Street, London; 36 years' references.

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Nine nearly new Steel Hopper Wagons, 4 ft. 8½in. gauge, 5 tons capacity.
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Brand new 4 ft. Under-driven Sand Mill.
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Two nearly new Steel Lancashire Boilers, 30 ft. x 9 ft., reinsurable at 100 lbs. working steam pressure, complete with steam and furnace fittings, etc. Five Lancashire Boilers, 30 ft. x 7 ft. 6 in., now insured at 150 lbs. pressure. Lancashire Boiler, 28 ft. 0 in. x 8 ft. 0 in. diameter, reinsure 130 lbs. pressure. Cochran Vertical Boiler, 19 ft. 0 in. x 6 ft. 6 in. diameter, reinsure 100 lbs. pressure. One Cornish Boiler, 18 ft. x 6 ft. diameter, reinsure 100 lbs. pressure. Four Marine Water-Tube Boilers, by Yarrow, Ltd., each 4,000 sq. ft. heating surface, reinsure 200 lbs. pressure. One Loco Type Boiler, barrel 4 ft. 7 in. long x 3 ft. diameter, reinsure 80 lbs. pressure. Large stock of Second-hand Flat-ended Circular Boiler Storage Tanks.

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| | |
|---|---|
| 24" Green's Cupolette | £24 |
| 28" Constructional Cupola | £35 |
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| 36" Evans Cupola (Good) | £60 |
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60" Evans Cupola (used 1 week)
66" NEW Whiting Cupola

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| | |
|---|---|
| 5 TON, geared, good | £42 |
| 1 TON EVANS, not geared, NEW | £20 |

**SHANKS.**

| | |
|---|---|
| (8) 2 Cwt. NEW | £3 |
| (18) 1 Cwt. NEW | £2 |

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